Understanding rural landholder responses to climate change

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Disclaimer

The views expressed in this report are solely the authors’, and do not necessarily reflect the views of Charles Sturt University, NCCMA or people consulted during the research project.

Cover photo: Rural scene from Kamarooka district (R Thwaites)
Executive Summary

The project

This report presents findings from qualitative social research exploring rural landholder perceptions and responses to climate change in the Muckleford and Kamarooka districts of North Central Victoria. This research formed part of a larger ‘Ecosystem Risk – Impacts of climate change’ project funded by the Australian Government and managed by the North Central Catchment Management Authority (NCCMA).

Research key questions

Three key questions were developed to guide our research:

1. At the property scale, what is the range of rural landholder beliefs and responses to climate variability?
2. To what extent are adaptations by private landholders consistent with NRM practices recommended by agencies?
3. How important is climate variability as a factor contributing to enterprise/land management decisions?

A decision making model

The research was informed by the authors’ synthesis of previously published work seeking to understand the influences on rural landholder adaptation to change (Mazur et al. 2008). Landholders operate in a complex and dynamic environment and people have different abilities and inclinations to respond to a range of conditions and stimuli. Those conditions and stimuli can be organised around different themes, including:

1. factors particular to each individual;
2. access to a range of resources;
3. the nature of the practice or adaptation response itself; and
4. factors associated with the broader operating environment.

Clarification of terms

Given the potential for confusion over the interpretation of the terms ‘climate variability’ and ‘climate change’, the following definitions have been adopted for this report:

‘Climate variability’ refers to the experience of landholders of past and current variations or trends in climate, including ‘drought’.

‘Climate change’ refers to change that is attributed to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.
The location
The NCCMA region is situated in north central Victoria, extending from the Murray River in the north to the Great Divide in the south, and from the Mt Camel Range in the east to the western boundary of the Avon-Richardson catchment in the west. With a population of over 200,000 and a diverse agricultural sector, much of the land is managed privately, and has been cleared. The natural habitat is fragmented, particularly on the flat plains to the north of Bendigo. Two case study areas were selected for this research, the Kamarooka zone located to the north of Bendigo and the Muckleford zone to the south. The Kamarooka zone encompasses flat plain and gentle hill country north of Bendigo, while the Muckleford zone broadly encompasses the hilly country to the south of Bendigo between the Campaspe and Loddon Rivers.

Research approach
With assistance from local NRM stakeholders, interview participants were selected to provide broad coverage of landholders with different characteristics (age, gender, land use type including farmers and non-farmers, dependence on farm income, permanent residents and ‘absentee’ landholders, time on property and so on).

Face-to-face interviews with landholders were organised around a small number of broad topics, with a number of probing questions to explore topics in greater depth. These topics explored the major changes in property management over the past 10 years and future challenges.

The field research was undertaken by a team of six in early March 2008. Thirty-six interviews were completed with 18 in each zone, with each interview taking on average a little over one hour. Interview transcripts were typically from two to eight pages in length. Data analysis involved a process of content analysis, whereby sections of text are coded according to themes identified either from the literature review, or from the interview data. As data is gathered into themes, common and contradictory elements are identified to link themes, explain patterns and ultimately to develop theory to respond to the research questions.

There were important differences in the characteristics of interviewees in Muckleford and Kamarooka. Properties in the Kamarooka zone were larger on average, and interviewees were more likely to be involved in cropping and have multiple enterprises on their properties. While there was a greater diversity of land uses across the Muckleford area, there was a higher proportion of specialised or single enterprise properties, and of smaller ‘lifestyle’ properties. Informants in the Muckleford zone were almost a decade older than those in the Kamarooka zone. In both areas the majority of informants were farmers by occupation, though there was a much higher proportion of non-farmers amongst those interviewed in the Muckleford Zone.

Key findings

The range of responses to climate variability by rural landholders
The landholders interviewed were making a conscious effort to cope with reduced rainfall and water availability. These responses include identifying new water supplies such as groundwater bores, capturing more surface water (by cleaning out and expanding dams, and installing tanks), and improving water use efficiency (by installing pipes and troughs, and in some cases adopting minimum till practices to
conserve soil moisture). Informants in both zones, but particularly in the Kamarooka zone said they had increased the area under lucerne (a deep-rooted perennial pasture species) in the last decade and that this had been important in maintaining enterprise viability through the dry times.

*Changes to climate and the wider economy have contributed to substantial enterprise adaptations amongst informants in this study.* While similar responses were reported in both zones, a pattern emerged where Muckleford zone landholders moved to low input and low management farming systems to reduce their financial risks, improve ecological sustainability and achieve their lifestyle preferences. By comparison, in the Kamarooka zone, landholders were more likely to be ‘farmers’ who sought to improve productivity by expanding, intensifying or refining their operations in other ways.

* Differences in the agronomic, biophysical and socio-economic characteristics of the two zones appear to underpin differences in the pattern of responses to climate variability.* Kamarooka landholders were also generally more optimistic about their ability to respond to market and climatic conditions, in part because of the benefits of improved technology (e.g. introduction of lucerne).

**Managing native vegetation in a drier environment**

As might be expected, a range of factors influenced landholder management of native vegetation in Muckleford and Kamarooka. This mix of factors includes values attached to native vegetation, prevailing economic conditions, drought, experience with recent revegetation efforts, the availability of labour and landholder capacity to maintain areas, relationships with agencies and organisations, regulations and expectations about future returns from providing environmental services.

*Landholders interviewed tended to fall into one of two broad groups: those who valued native vegetation for its production values and those who valued native vegetation for its conservation values.* Farming as an occupation and dependency on income from agriculture are more common in Kamarooka than Muckleford. It is not surprising then that the conservation values of native vegetation were more highly rated by landholders in the Muckleford area and production values rated more highly in the Kamarooka area.

*Landholder values appeared to influence their land management.* Some interviewees with strong conservation values said they intended to ‘revegetate’ degraded land. For some in the Muckleford zone, revegetation or ‘regeneration’ was their primary land management objective. In both zones, landholders identified remnant vegetation they wished to protect. Often these remnants were along creeks and efforts had been made to exclude stock and regenerate such areas. Paddock trees were identified as being under threat in both areas and the widespread concern about the declining health of paddock trees was reflected in a desire for information and assistance with the management of paddock trees. Nevertheless, few landholders appeared to have made substantial efforts to protect or replace such isolated trees.

*Efforts to encourage conservation of native vegetation become more problematic when production and conservation values are in conflict.* In the Muckleford area native grasslands are now mostly confined to the less accessible and low fertility hillsides. Most Muckleford interviewees, including those with a commercial agriculture focus, attach high conservation values to these grasslands and have or are considering destocking. Native grasslands are increasingly under threat in the
Kamarooka area because landholders seeking to maximise production now have the
capacity to convert low-lying areas with heavy soils into lucerne pastures.

*There was also evidence that these value conflicts shaped landholder responses to remnant vegetation programs.* There was some evidence of landholders ploughing
native grasslands ahead of the introduction of the ‘ten year’ regulations to ensure they
didn’t lose the potential to use areas for production. Some landholders said they
would not enter into agreements to implement programs if the activities proposed
would restrict their capacity to generate an income. Muckleford interviewees were
more likely to say that the advice and support offered by organisations, including the
NCCMA and Landcare was important in helping them implement work to conserve
native vegetation. On the other hand, Kamarooka interviewees were more likely to
say that access to labour and financial support for the purchase of materials were
important incentives for them to take on revegetation work.

*The ongoing dry conditions have resulted in decreased planting of native trees and
shrubs in both zones and there was some evidence of increased grazing of areas
previously fenced to manage stock access to native vegetation.* Some interviewees
reported low survival rates for tree seedlings from planting and direct seeding. There
was also evidence that the drought had reduced landholder engagement in Landcare
and group activities. At the same time, many interviewees said they intended to
establish native vegetation in the future.

**Importance of climate variability as a factor contributing to enterprise/land
management decisions**

As might be expected, a large number of factors were identified by informants as
affecting decisions about enterprise and land management. These factors were found
to interact with each other in complex ways, but can be related to the themes
identified in the decision making model identified above. The factors include:

**External operating environment**

- Climate, particularly lack of rainfall.
- Water supply, including irrigation water supplies and markets.
- Economic issues, including market prices for commodities and inputs.
- Social issues related to rural population decline, the ‘tree-change’
  phenomenon, rising land values, increased environmental awareness, changes
  in consumer behaviour as a result of animal welfare campaigns, and declining
  levels of farmer autonomy (also *Access to resources*).
- The role of government, including international trade agreements, incentives
  offered for natural resource management, current and future regulations.
- New technologies including the introduction of new pasture varieties, direct
  drilling, chemicals, larger machinery and GM technology (also *Access to
  resources*).
- Physical environment including proximity to urban centres and access to
  markets, nature of the terrain and soil type.

**Landholder characteristics**

- Personal attributes of landholders including their long-term goals/aspirations,
  personality type, values, and experience and training.
Personal situation of landholders including their family relationships, stage of life, health, role in property management, succession planning and extent of family heritage/connection.

Approach to risk management including the landholder’s level of risk aversion, familiarity with risk, extent of on and off-property diversification, level of debt, level of control over input costs, climatic uncertainty and crop sowing times (also Access to resources).

Access to resources

Labour issues including the capacity of the individual and family to provide labour inputs, the cost and ability to source labour (also Landholder characteristics).

About half of our interview respondents expressed views that suggest they believe climate change is a reality, with slightly more ‘believers’ in Muckleford than Kamarooka. The main difference between the two zones was that in Muckleford almost all of those not expressing belief in climate change were ‘unsure’, whereas in Kamarooka they were clearly ‘non-believers’.

Farming as an occupation appears to be an important factor mediating responses to climate change. Despite a high proportion of ‘non-believers’ amongst Kamarooka informants, the Kamarooka landholders have demonstrated a high level of capacity to respond to ongoing drought, to a large extent because they had the ability to include lucerne in their farming systems.

Overall, there were few differences in the challenges identified by ‘believers’ and ‘non-believers’ in climate change or informants in the Kamarooka and Muckleford areas. At some point in the interview process, every informant touched on the influence of climate variability on their land management. Both climate and economic issues were frequently mentioned, though, only a minority of interviewees identified climate variability or ‘climate change’ as the most significant issue they faced in their decision making.

‘Non-believers’ were typically more confident in their ability to adapt to drier climate. ‘Believers’ and those who were ‘unsure’ about climate change were typically less confident of their ability to adapt successfully. In the Muckleford area this lack of confidence in adaptive capacity was associated with high levels of personal stress.

There were some important differences in the responses of landholders interviewed in Kamarooka and Muckleford to drought and climate change. Adoption of lucerne by many Kamarooka landholders is a good example of the contrast between the two areas. Kamarooka interviewees explained that lucerne, in combination with the efficiency gains from adopting minimum tillage technologies and larger equipment had helped them cope with the current drought better than previous droughts. This trend represents a powerful example of the capacity of landholders to adapt to drought and climate change, highlighting the important role that the physical environment and access to natural resources may play in adaptive capacity.
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List of Acronyms

ABARE .... Australian Bureau of Agricultural and Resource Economics
ANU ........ Australian National University
CERF ...... Commonwealth Environment Research Facilities
CMA ....... Catchment Management Authority
CSIRO ..... Commonwealth Scientific and Industrial Research Organisation
CSU ........ Charles Sturt University
DSE ........ Department of Sustainability and Environment
DSE ........ dry sheep equivalent
GM ......... genetic modification; genetically modified
IPCC ....... Intergovernmental Panel on Climate Change
MAFF ....... Minister for Agriculture, Fisheries and Forestry
NASA ...... National Aeronautics and Space Administration
NCCMA ... North Central Catchment Management Authority
NRM ...... natural resource management
OH&S ...... occupational health and safety
UNFCCC ... United Nations Framework Convention on Climate Change
Section 1: Introduction

1.1: The project

This report presents findings from qualitative social research that explored how rural landholders in the Muckleford and Kamarooka districts near Bendigo, Victoria, perceive and manage the risks associated with climate change. This research formed part of the larger ‘Ecosystem Risk – Impacts of climate change’ project funded by the Australian Government and managed by the North Central Catchment Management Authority (NCCMA). With contributing partners from the Victorian Department of Sustainability and Environment (DSE), CSIRO, Australian National University (ANU) and Charles Sturt University (CSU), the Ecosystem Risk project aimed to assess the impact of climate change on key terrestrial vegetation communities in Victoria, and develop risk assessment methodology and decision tools to help guide adaptation actions (NCCMA, 2008). Given this focus, the social research component included consideration of landholder responses to climate change for the management of native vegetation.

1.2: Research objectives and key questions

The research objectives were:

1. Describe the extent of adaptation (range of responses) by private rural landholders to climate variability;
2. Explore the factors influencing landholder responses to climate variability to provide better understanding of the decisions made;
3. Provide information to underpin more informed decision making by landholders; and
4. Provide information to assist natural resource management (NRM) agencies more effectively engage rural landholders in climate change and native vegetation management.

Based on these research objectives, three key questions were developed to guide our research:

1. At the property scale, what is the range of rural landholder beliefs and responses to climate variability?
2. To what extent are adaptations by private landholders consistent with NRM practices recommended by agencies?
3. How important is climate variability as a factor contributing to enterprise/land management decisions?

1.3: Report structure

Section 2 provides a background to the project, including a theoretical model for understanding landholder decisions making developed through a literature review (Mazur et al. 2008) undertaken as part of this project. Section 3 outlines the methodology employed and Section 4 presents the research findings. The concluding section draws together these findings in the context of the theoretical model proposed, considers aspects of risk related to climate, and the implications of the findings for biodiversity management.
Section 2: Background

2.1: Issues for North Central CMA

The NCCMA region is situated in north central Victoria, extending from the Murray River in the north to the Great Divide in the south, and from the Mt Camel Range in the east to the western boundary of the Avon-Richardson catchment in the west (NCCMA 2003). The region covers four major river catchments, namely those of the Campaspe, Loddon, Avoca and Avon-Richardson rivers, and covers almost three million hectares or 13% of Victoria’s total area (NCCMA 2003).

Approximately 13% of the NCCMA region is public land managed for various values, including forestry, recreation and conservation. With a population of over 200,000 in the region, and a diverse agricultural sector, much of the land has been cleared, and the natural habitat is fragmented, particularly on the flat plains to the north of Bendigo (NCCMA 2003).

Most of the NCCMA region is managed by private individuals. If the NCCMA is to achieve its goals for biodiversity conservation, the CMA must build effective partnerships with these private landholders. To effectively engage landholders, the CMA must understand landholder motivations and capacities (Pannell et al. 2006).

Australian farmers are experiencing difficult times, with ongoing droughts, increased input costs, an appreciating currency reducing returns on some exports and difficulties attracting labour. In some instances, these factors have resulted in the amalgamation of properties, families leaving the land and rural population decline. On the other hand, there have been population increases in some rural areas, mostly in attractive natural areas or close to the major cities and regional centres. In these amenity landscapes (Barr et al. 2005) there is ongoing subdivision and increased proportions of non-farmer landholders (Curtis et al. 2008). Government policies have also aided the rapid expansion of large scale Managed Investment Schemes resulting in the expansion of agro-forestry and other horticultural activities in some areas.

The NCCMA Regional Catchment Strategy noted some of these trends.

“Regional population growth is exceeding the average for Victoria. While population growth is strong in non-urban areas, this tends to be concentrated in rural living zones. There is a migration away from agricultural areas to provincial centres and to Bendigo. The population is ageing and the proportion of young people remaining in the community is declining” (NCCMA 2003, 6).

A report from the Department of Climate Change (Campbell 2008) has highlighted the need for climate change to be considered as core business for CMAs. The most recent climate change modelling from CSIRO for the NCCMA region suggests there will be a warming and drying trend, more frequent and intense droughts and decreased stream flow (DSE 2008a). Based on a medium emissions growth scenario, annual warming of between 0.6°C and 1.2°C is expected by 2030, with an annual decrease in rainfall likely of around –4% (between +1% and –9%) by 2030, and a decrease in runoff in the Campaspe and Loddon River catchments by as much as 35% by 2030. These figures could be considerably warmer and drier for higher emission scenarios (DSE 2008a).
These trends in population, land use and climate offer both opportunities and challenges for landholders, and for biodiversity management. They also provide the broad context for the ‘Ecosystem Risk – Impacts of climate change’ project.

2.2: Previous climate change research in NCCMA region

Preliminary research undertaken by the authors in the North Central region during 2005-2006 sought to understand landholder perceptions of climate change and views about adaptation strategies they might employ (McDonald et al. 2006). The political context of climate change has altered substantially since that research was completed. For example, there is a new federal government with very different views about climate change to those of the previous government (e.g. the Australian government now has a Department of Climate Change). Nevertheless, the previous research employed a similar approach to data collection (in-depth interviews with selected landholders) and the findings of that research helped frame the more substantial research documented in this report. Key findings from McDonald et al. (2006) were that:

- all informants had experience and understanding of climate variability, but there was generally low awareness of and confusion about climate change and its impacts;
- there was a range of attitudes towards climate change, with some sceptics, others were believers. Most informants were in the “I don’t believe in it” or “wait and see” categories;
- informants thought that efforts by government to inform them about climate change and its impacts had been unsuccessful. For example, information needed to be more relevant to their enterprise and specific to their local area;
- interviewee’s scepticism and uncertainty about climate change resulted in uncertainty about how it may affect on-farm enterprise activities and future viability;
- some informants believed climate change would have little effect on them. With a focus on drought and past experience of climate variability and adaptation, they felt that other concerns were more important for on-farm enterprise viability; and
- there was a high level of confidence in society’s ability to generate technologies to support mitigation and adaptation, and informants were generally confident in their own capacity to adapt.

2.3: Decision making model

This project has been informed by work undertaken by the authors and other social scientists seeking to understand the influences on rural landholder adaptation to changes in their environment, in relation to natural resource management and to climate change (Pannell et al. 2006; Cary et al. 2002; Nelson et al. 2006; Reid et al. 2007) [Figure 1]. Figure 1 shows that landholders operate in a complex and dynamic environment. People have different abilities and inclinations to respond (making decisions about how to act in the short and long term) to a range of conditions and stimuli that occur at different scales. Those conditions and stimuli can be organised around different themes, including:

- Factors particular to individuals (range of personal characteristics, such as their value and belief systems, attitudes and perceptions, personalities, goals
and motivations) – these come together to inform their choices about how they manage their properties, particularly the extent that they are motivated to undertake certain practices (new or otherwise) on their properties. For example, a landholder’s belief in climate change, their perception that climate change poses a tangible risk to what they value, and their perceptions that they have the (personal) ability to act will increase their intention of taking some kind of action.

- The **range of ‘resources’** (social, human, financial, physical, natural) in their immediate environment that they (consciously and unconsciously) draw on will also inform their decisions about whether they can make certain changes to their practices. These factors might include the condition of the natural assets/resources on their property (e.g. access to water, soil condition, amount and health of remnant vegetation), social capital (e.g. their degree of connectedness to social and information networks, family support), human capital (e.g. their knowledge or labour availability), financial capital (e.g. their income levels and the economic viability of their enterprise, etc.) and physical capital (e.g. farm equipment).

- The **nature of the practice** they are considering or have taken up in response to some kind of change – essentially the feasibility and benefits of the practice as seen by different landholders. Consideration of these issues may include asking such questions as ‘Will it work?’, ‘How will it benefit me/my business?’, ‘Are others doing it?’, ‘Can I trial it?’ The attributes of practices intended to mitigate or provide some kind of adaptation to climate change are also informed by external factors, such as the rationale and resources of government and/or science agencies who may have designed and disseminated/delivered those practices in some way.

- The **regional agricultural systems and broader operating environment** which generates a range of conditions and stimuli considered ‘external’ to a landholder’s immediate environment; things that are generally considered to be beyond the direct control of a landholder. These include, but are not limited to, economic conditions and pressures; government policies, legislation, programmes and priorities; public pressures; and environmental conditions, such as climate change.

Figure 1 also illustrates the different levels or scales of influences on individual and family decision-making.

Recent research in climate change adaptation has been concerned with identifying ways of reducing the negative impacts of climate change on agricultural enterprises and improving people’s capacity to make positive changes (adaptations). Researchers have sought to identify what makes people/farm enterprises more vulnerable to climate change impacts and have concluded that **vulnerability** comes from being exposed to factors that reduce adaptation/adaptive capacity, including the stimuli and conditions shown in Figure 1. These variables can be sources of exposure sensitivity (risk of not adapting or coping, constraints or barriers to change) or determinants/drivers of adaptive capacity (e.g. not believing in climate change acts as a source of exposure sensitivity, whereas believing in climate change drives adaptive capacity).
Figure 1: Factors influencing adaptation (adapted from Pannell et al. 2006; Cary et al. 2002; Nelson et al. 2006; Reid et al. 2007)
Furthermore, while some external exposures and adaptive capacity determinants will be common to individual landholdings, the property location and characteristics of individual landholders can vary greatly. Consequently, vulnerability to climate change can vary considerably across a region. This variation means that an agricultural system’s vulnerability will be determined by aggregate condition of landholding/farms in that region.

2.4: Clarification of terms

Language is an important part of environmental discourse – it is part of the construction, interpretation, discussion and analysis of conversations (Dryzek 1997). Dialogue about the phenomenon of the warming of the Earth’s climate, implications of that warming, and required responses to those changes has been variously and sometimes interchangeably referred to as ‘global warming’, ‘climate change’, or ‘climate variability’.

Climate variability has been defined as irregular patterns or extreme conditions, such as more frequent droughts, or deviations from normal growing season conditions (Smit and Skinner 2002). The Intergovernmental Panel on Climate Change (IPCC) defines climate change as any change in climate over time whether due to natural variability or resulting from human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to change that is attributed to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC 2007). In this research we have followed the interpretation of the UNFCCC in our use of the term ‘climate change’. While climate variability is a feature of the Australian experience, modelling suggests that ‘climate change’ will increase that variability (DSE 2008b).

Other climatic phenomena like ‘drought’ have also been challenging to define. Some argued earlier this decade that ‘drought’ needed to be recognised as a complex but ‘normal’ part of Australian agriculture – a consequence of a highly variable climate and should be referred to as part of ‘climate variability’ (Botterill and Fisher 2003; Lindesay 2003). Recent national dialogues position ‘drought’ as something that will be affected by ‘climate change’ – with a projected two-fold increase in their frequency and severity (Hennessy et al. 2008). The current National Drought Policy is being reviewed with a view to better preparing farmers, rural communities and Australia’s primary industries for the challenges of ‘climate change’ (MAFF 2008). This review signals a policy shift from treating drought and climate change separately and a movement towards linking drought preparedness and climate change adaptation (Milne et al. 2008). In this research, the term ‘climate variability’ refers to the experience of landholders of past and current variations or trends in climate, including ‘drought’.

Lorenzoni et al. (2006) suggested that the shift from the term ‘global warming’ to ‘climate change’ was part of a strategy by sceptics to neutralise the seriousness of the phenomenon. Similarly, previous research in the NCCMA region (McDonald et al. 2006) found climate change to be both poorly understood and a highly politicised term implying allegiance to a particular political party or way of thinking. Regardless of how ‘climate change’ is perceived by scientists, individual perceptions of its meaning are likely to relate more to the public discourse than the science. In framing this research we acknowledged that ‘climate change’ is not generally seen in terms of
the neutral IPCC definition (independent of causality), but is likely to be perceived as value-laden and part of a wider debate about the extent of human influence on climate.

2.5: **Assumptions about the farming context of the research**

This study makes a number of further assumptions that arise from the published literature discussed above. These assumptions informed development of our research methodology and should be articulated.

- Farming is inherently a risky business and farmers/landholders assess risk as part of the decision making process;
- Not all landholders are farmers by occupation and there are important differences in the motivations and capacities of these two groups of rural landholders;
- There may be many factors that influence landholder decisions, one of which is climate variability;
- Climate variability has always been a part of life for farmers and landholders;
- A range of adaptive responses to climate variability are available to landholders;
- There will be a complex web of factors shaping responses to climate variability which account for individual differences in responses, but these may include availability of credible information from trustworthy sources, and the policy environment in which landholders operate;
- Farmers are rational actors, and it should be possible to establish their reasons for making management decisions; and
- NRM agencies can influence landholder decisions in a number of ways, including through the policies and programs that support mutually desired outcomes.
Section 3: Methodology

3.1: Introduction

With little published research examining landholder responses to climate variability in Australia, and given the short time-frame for this research, this project was designed to be an exploratory study of:

- rural landholder understanding and beliefs about climate change;
- the extent of any adaptations to climate change; and
- the relative importance of climate change as a factor affecting land management.

The intention was also to develop a methodology that could be employed in other case studies, including forthcoming research by the authors under the Commonwealth Environment Research Facilities (CERF) Landscape Logic program (www.landscapelogic.org.au). Given this context, we chose to use face-to-face interviews to gather qualitative data. The interviews were organised around a small number of broad topics (semi-structured). The longer-term objective was to use the knowledge and understandings gained through the NCCMA study to develop a quantitative methodology.

In summary, the research was framed by the following objectives:

- Describe the extent of adaptation (range of responses) by private rural landholders to climate variability;
- Provide better understanding of the factors influencing landholder responses to climate variability to understand the decisions made;
- Provide information to underpin more informed decision making by landholders; and
- Provide information to assist NRM agencies more effectively engage rural landholders in climate change and native vegetation management.

Based on these research objectives, three key questions guided our interviews with landholders:

1. At the property scale, what is the range of rural landholder beliefs and responses to climate variability?
2. To what extent are adaptations by private landholders consistent with NRM practices recommended by agencies?
3. How important is climate variability as a factor contributing to enterprise/land management decisions?

3.2: Case study approach

Landholder decision making is complex and substantially influenced by context. That is, landholder decision making needs to be understood in terms of a range of factors that include the activities of local organisations and networks and their influence on the communication of knowledge, understanding of environmental and farming processes/practices and shaping of social norms. It is difficult to understand the influence of context if data is not gathered from a substantial number of people within a particular social setting. A comparison of case studies allows researchers to further explore the influence of context.
Figure 2: Location map of Kamarooka and Muckleford zones
In consultation with project partners, including ecologists from the Victorian government’s Department of Sustainability and Environment (DSE), we identified the Kamarooka and the Muckleford areas as useful case studies within the NCCMA region [Figure 2]. From the ecologist’s perspective, these areas were part of a larger vegetation type of state-wide significance that was expected to be affected by climate change. From our perspective as social researchers, the case studies presented very different social contexts in that Muckleford was closer to Melbourne with a larger proportion of non-farmers and absentee landholders, and landholdings were considerably smaller and less likely to be used for cropping.

3.3: The interview process

Given the scale and budget of this project and our experience with similar projects, a target of 40 landholder interviews was established (20 per case study). A preliminary interview schedule was developed to guide the field research team through their landholder interviews. The schedule included a small number of broad questions [see Box 1], and a number of subsidiary questions or probes that could be used to explore topics further. The draft interview schedule was reviewed by the members of the research team and then piloted with a landholder from the Corangamite catchment. Changes were made to the interview schedule as a result of the pilot interview experience.

<table>
<thead>
<tr>
<th>Box 1: Interview schedule key topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>An Interview schedule provides a guide to the interviewer undertaking semi-structured interviews. The full interview schedule [see Appendix 1] contains further questions to explore these topics in greater depth.</td>
</tr>
</tbody>
</table>

**Question 1: What is your personal and farming (land management) background, and how do you manage your property?**

This topic area seeks to get the interview going by giving the informant some freedom to identify what is important to them, their background, history of property and land use (including remnant veg), and ultimately provide something on their values.

**Question 2: What have been the major changes you’ve undertaken on your property in the past decade (e.g. physical, management approach, enterprise mix, expectations, lifestyle), and why?**

This topic area seeks to understand the factors that have influenced or changed their property management.

**Question 3A: What are the major challenges you expect to face in the future, and how important is climate change (climate variability?) to your farming future?**

This topic explores perceptions of important future threats and influences to land management/enterprise, and responses to these. Asks specific questions on understanding of climate change, the threat it poses and how they might respond.

**Question 3B: If informant gives negative response to issue of climate change - If informant does not believe in ‘climate change’, explore perceptions of future management approaches available and the role of climate variability.**

**Question 4: Remnant vegetation**

Return to discussion of remnant veg, for specific information on remnant veg on property, management approach and future plans.
The final interview schedule contained four sections. The introductory section was designed to gather some background information about the interviewee, their property and land use. The second section sought information about the major changes in property management in the last ten years. The expectation was that this section would include a discussion of the factors that influenced these changes. The third section explored the major future challenges or threats that the informant thought they would face in managing their property, including their attitudes towards and perceptions of climate change. This section could be varied depending on whether the informant ‘believes’ in climate change or not. The final section focused on the management of remnant vegetation on the property. The full interview schedule is provided in Appendix 1.

At the end of each interview, a brief structured questionnaire was given to each interviewee. The questionnaire asked for basic demographic and property management information and is included as Appendix 2.

Any research by the authors involving the survey of individuals for their views or opinions requires approval from Charles Sturt University’s Ethics in Human Research Committee. A key issue for ethics in social research is that participants are providing ‘informed consent’. The Information Sheet and Consent Form provided to each interviewee are also provided as Appendix 3.

### 3.4: Selection of respondents

Qualitative researchers often select interview informants purposefully rather than identifying a representative sample from a population of informants. Purposeful sampling involves the researchers making decisions about the types of people likely to provide the most useful information or insights given the research questions (Sarantakos, 1998).

Discussions with our key partners in the Ecosystem Risk project confirmed that we should include landholders with the following characteristics in our interviews:

- older (over 65 years) and younger landholders;
- males and females who are the principal enterprise operator/decision maker;
- commercial farmers and non-farmer landholders;
- permanent residents and absentees/‘weekenders’;
- landholders with different level of dependence on off-farm income;
- new landholders (less than ten years on property) and longer term landholders;
- multi-generational landholders (three generations or more);
- those engaged/not engaged with NRM networks and information (Landcare, CMA etc.);
- irrigation and dryland farmers; and
- those working in different industries, including dairy, livestock, cropping and horticulture.

Workshops were held in January 2008 with local stakeholders in each case study area to identify potential informants across the list of characteristics identified above. Workshop participants represented the spread of key NRM stakeholders in the case study areas, such as local Landcare groups; Victorian Farmers Federation and other farm groups; Department of Primary Industries extension officers and local government. Lists of potential interviewees were prepared based on the knowledge of stakeholders present. All potential interviewees on each list were contacted by the
research team, provided with information about the project and invited to participate. This process resulted in a provisional list of just over 20 potential interviewees for each case study area.

### 3.5: Field research

The field component of the research was undertaken by a team of six experienced researchers and completed during a week in early March 2008. In the field, the researchers worked in pairs, one as the interviewer and one as the scribe for each interview. These roles were rotated for successive interviews and the members in each research team were rotated each day. Interviews lasted for up to two hours, but on average took a little over an hour. A debriefing session at the end of each day enabled the researchers to assess the effectiveness of the interview schedule and to make preliminary analyses of data. Interviews were recorded by hand by the scribe. A total of 36 interviews were completed during the week, with 18 interviews from each case study area.

A summary of the key characteristics of the interviewees and their land uses is presented in Table 1 below. Information in Table 1 suggests that the interviewees represented a spread across the desired interviewee characteristics (see above). For example, ten interviews involved a female, including three where a woman was the principal land manager. (There were eight multi-person interviews, including one with two females.) A higher proportion of interviews in the Muckleford zone involved females (four interviews in Kamarooka compared with six in Muckleford — one with two females).

There were important differences in the characteristics of interviewees in Muckleford and Kamarooka. For example, the median age of informants in the Muckleford zone was almost a decade older than those in the Kamarooka zone. On the other hand, property sizes were much larger in the Kamarooka zone. In both areas the majority of informants were farmers by occupation, though there was a much higher proportion of non-farmers amongst those interviewed in the Muckleford zone\(^1\). There was no difference between informants from the two zones in terms of the period of their property management, though Kamarooka properties had often been in the hands of the same family for longer. Informants in the two zones had very different enterprise profiles. The Kamarooka interviewees were more likely to be involved in cropping and have multiple enterprises on their properties. While there was a greater diversity of land uses across the Muckleford area, there was a higher proportion of specialised or single enterprise properties [Table 1 and Figure 3].

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\(^1\) There may be numerous ways in which people could be categorised as farmers or non-farmers, including size of property, proportion of income generated on farm, nature of land use, and so on. For this study, the definition of a farmer is based on each informant’s self description of occupation, and does not include any thresholds relating to property size or income derived from agriculture, as identified for example in definitions used by the Australian Tax Office, or ABARE. This may mean that a ‘farmer’ may not currently be operating a commercial farm business (e.g. a retired farmer). This definition has been adopted for this study as the research seeks to explore landholder beliefs and values (e.g. their views of climate change), as well as on-farm adaptation/responses. It was felt that these personal values would link better with their personal perception of occupation.
Table 1: Summary of interviewee characteristics

<table>
<thead>
<tr>
<th></th>
<th>Muckleford</th>
<th>Kamarooka</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Males</td>
<td>15</td>
<td>18</td>
<td>33*</td>
</tr>
<tr>
<td>No. Females</td>
<td>4</td>
<td>7</td>
<td>11*</td>
</tr>
<tr>
<td>No. Age less than 40</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>No. Age over 65</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Median Age (yrs)</td>
<td>54</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td>No. Farmers</td>
<td>13</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>No. Non-farmers</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>No. managing property &lt;10 yrs</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>No. managing property &gt;30 yrs</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Median time managing (yrs)</td>
<td>16.5</td>
<td>20.5</td>
<td>19</td>
</tr>
<tr>
<td>Median time property in family (yrs)</td>
<td>46</td>
<td>81.5</td>
<td>61.5</td>
</tr>
<tr>
<td>No. Property size &lt;100 hectares</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>No. Property size &gt;1000 hectares</td>
<td>2</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Mean property size (hectares)</td>
<td>374</td>
<td>1576</td>
<td>975</td>
</tr>
<tr>
<td>No. with Sheep</td>
<td>8</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>No. with cattle</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>No. cropping</td>
<td>2</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>No. with regeneration/reveg. as primary use</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

*More than one person interviewed in some instances

3.6: Data analysis

Data generated from a semi-structured interview approach is in the form of text that can be analysed using content analysis (see below). Interview transcripts were typically from two to eight pages in length. However, analysis of interview data began at the time of the interview as the interviewer responded to the information provided and made judgements about the direction of the interview, including the nature of probes. Reflection continued after the interview as part of the process of further refining the interview schedule to better explore key questions or emerging topics of interest. The daily debriefing sessions facilitated these processes and allowed the research team to identify and explore some preliminary findings. Notes from these meetings were retained for later use.

After returning from the field, a process of content analysis was applied to the interview transcripts to identify key themes relevant to the key research questions. To do this, sections of text were coded by themes that had either been identified by our literature review or from the interview data. For example, we coded text about the type of adaptation landholders were making, and the factors affecting landholder’s decisions about land management. Data interpretation also involved the search for common and contradictory elements and attempts to link themes to explain patterns and develop theory that would answer key research questions.
Figure 3: On-property enterprises of Kamarooka and Muckleford interviewees
Section 4: Results

4.1: Research Question 1: At the property scale, what is the range of responses to climate variability?

Farming is a complex business, with a great many interacting factors shaping land management decisions. This section of the report describes how individual landholders have responded to challenges they faced, particularly their adaptation to climatic variability.

4.1.1: Overview

As indicated by Figure 1, external conditions are an important influence on landholder decisions. Specific challenges arising from these external conditions have been well documented, particularly in relation to climatic and agribusiness conditions (‘environmental conditions’ and ‘economic/market conditions’ in Figure 1). Landholders interviewed in the Muckleford and Kamarooka areas have responded differently to these challenges, in part because of the socio-economic and agronomic heterogeneity of the two communities. Many of the adaptations described below reflect the dynamic inter-relationships between climatic conditions, agribusiness opportunities and constraints, and personal capacity and aspirations (‘landholder characteristics’ in Figure 1).

The adaptations or responses by landholders in the two study areas appear to vary broadly according to:

- the characteristics of individual landholders (e.g. lifestyle and farming preferences, skills, age, family heritage, stage of business cycle such as expanding or retirement); and
- access to resources which in turn influences the capacity of the farm business to respond to changes in the operating environment (e.g. agronomic potential, scale of operation, infrastructure, level of debt/equity and income).

The on-farm adaptations by landholders reported in this research have been analysed for the two study areas (i.e. Muckleford and Kamarooka), and between ‘farmers’ and ‘non-farmers’. These adaptations are discussed below.

4.1.2: Links between climate, agribusiness and social conditions

The past decade in central Victoria has been drier than expected, with considerably less rainfall than the long-term average. Not surprisingly, most landholders – both commercial farmers and non-farming landholders – said they had made substantial investments in infrastructure to collect and store additional water supplies, including drilling bores, cleaning-out and expanding dams and installing tanks; and to improve water-use efficiency, including by installing pipes and trough systems. Some authors refer to these changes as ‘strategic’ adaptations as they require investment in long-term or enduring changes to the property’s infrastructure and/or management (Reid et al. 2007; Milne et al. 2008). By comparison, ‘tactical’ adaptations involve relatively short-term or temporary changes to the property’s management.

Most landholders said that farming had been particularly challenging and stressful during the past decade. Reasons for the increased stress associated with farming included the trends to lower rainfall totals and changes in the seasonal distribution of
rainfall contributing to crop failures and reduced pasture growth; and declining terms of trade (i.e. profit margin squeezed as the cost of inputs such as fertilisers rose faster than prices paid for outputs). The stresses associated with farming were in turn being expressed within families and the local community and included positive and negative impacts. For example, some informants reported closer ties with their neighbours while others reported increased tensions with neighbours. Many of the landholders interviewed said that planning for property succession was a source of additional stress given the low returns from agriculture and the likelihood that the next generation wouldn’t want to take up farming for a living. This was a particularly difficult issue for those farmers where the property had been held within the family for several generations.

In their response to these conditions, including climate change, some of the landholders interviewed had moved toward low-input/management systems, reflecting an underlying belief that a low input system is more sustainable (ecologically and economically) and desirable (lower workload). A number of the farmers interviewed had moved into wool (merino sheep) for this reason. By contrast, farmers interviewed with larger properties that have fertile soils and good access to water were expanding (e.g. leasing farmland), intensifying (e.g. increasing production of new crops and pastures) and refining (e.g. ‘dry’ sowing of crops, increasing lucerne-based pastures) their farm businesses. Again, these can be considered as strategic adaptations as these require relatively enduring changes to the farm business, rather than just changes for the short-term (e.g. less than three months).

Kamarooka and Muckleford are very different farming contexts, with Kamarooka properties much larger and more suited to cropping. Not surprisingly, many of the farmers in the Kamarooka district were optimistic about their ability to manage in the current conditions, including under climate change. In contrast, many landholders in the Muckleford district were uncertain and even pessimistic about their ability to manage in the current conditions.

4.1.3: Responses to the challenges of change by landholders in Muckleford

Non-farmers (n=5)

Non-farmer (by occupation) interviewees in the Muckleford area were very committed to land repair activities (e.g. reducing the grazing of livestock, establishing native vegetation). These conservation activities aligned closely with their lifestyle goals of ‘sustainable’ living and self-sufficiency. One non-farmer reported that on their small lifestyle property (9.5 ha) they have removed all livestock and had been replanting with local native species. They still live in Melbourne and stay at the property for occasional long weekends. When at the property, they spend much of their time on revegetation activities and weeding by hand (cape broom, briar, gorse, blackberry). Another property was purchased with the intention of rejuvenating the remnant bush and establishing a farm forestry enterprise (with long-term timber species). This landholder had also removed all livestock from what was previously a sheep property. Another landholder had developed their small three hectare property with the goal of achieving self-sufficiency in food production. The property was surrounded by publicly-owned native forest. When the property was purchased it had been ‘treeless’ and after removing livestock, the new owners had observed native bush regenerating on the property.
Most of the non-farmers interviewed did not rely on property-based enterprises for their household income. Nevertheless, the drier than expected seasons over the last two years had reduced their investment in land repair works. One landholder said that most of the trees/shrubs they had planted had died during the recent dry years. They had decided to plant ‘opportunistically’ (small areas after good winter/early spring rainfall) until there was evidence of a more reliable rainfall pattern. Consistent with their strong conservation values, this landholder reported increased effort on weed control (a focus on prickly pear), including with the local Landcare group.

Another interesting example illustrates the complex interaction between environmental and social conditions. A landholder had been developing a ‘lifestyle’ property for the past 15 years by removing livestock, encouraging the regeneration of native vegetation, revegetating with native plants and controlling pest plants and rabbits. During the recent dry years, this person had allowed neighbours to run a few horses on the property because there was so little feed for livestock in the district and they wanted to engender goodwill towards their neighbours. Although this landholder believed they had prepared their property to the stage where they could cope with dry seasons (e.g. reduced water use, installation of a rainwater tank), this person also said it was difficult living in a community under stress from drought. Another interviewee highlighted the negative impacts of recent dry seasons on the farming community (e.g. low viability of farm businesses, the sense of depression amongst farming communities). Several of the other non-farmers interviewed also reported that recent dry seasons had prompted greater investment in water efficiency (water recycling) and water storage (rainwater tanks).

**Farmers (n=13)**

Farmers (by occupation) in the Muckleford area were employing four strategies to respond to the challenges of their operating environment, including climate change. These adaptations are summarised in the following paragraphs and explained in detail in subsequent sections. In the first instance, the farmers interviewed were making substantial investments in infrastructure. These investments included drilling bores, cleaning-out and expanding dams and installing tanks to collect and store additional water supplies, and installing pipes and trough systems to improve water-use efficiency. Access to reliable water supplies for irrigation markedly altered the business opportunities and on-farm management of the farmers interviewed.

The second strategy involved developing low-input and low-management farming systems. For example, increasing the importance of sheep for wool (+/– meat) and reducing cattle numbers to reduce agronomic/financial and ecological risks by reducing input costs and better matching the livestock enterprise to pasture availability.

The third strategic response involved identifying and supplying niche markets based on systems suited to drier seasonal conditions. Examples in Muckleford included goat milk, wine grapes and seeds from native plants.

The final strategic approach evident in Muckleford was by a sheep farmer with a substantial holding who had expanded by leasing additional land. This farmer was also increasing the productive capacity and resilience of their pastures by replacing annual with perennial species. Perennials are generally deeper rooted and summer active compared to annual grasses, and therefore capable of utilising summer rainfall.
Other farmers were continuing with existing enterprises but adopting strategies to improve the viability of their enterprises under drier conditions. Other strategies include the move to rotational grazing to increase productivity; changing from spring to autumn shearing and lambing to exploit a marketing opportunity at that time; and sowing lucerne pasture. Lucerne is a deep-rooted perennial pasture that provides high quality grass and hay. As with the non-farmers, there was evidence of farmers reducing the scale of revegetation with native plants and increasing their weed control activity, in part due to increased prevalence of weeds in the district.

**Low-input farming**

Several Muckleford farmers reported their shift toward low input farming, with this strategy usually viewed as a means of reducing financial risk, minimising environmental degradation and achieving a lifestyle goal. For example, an elderly farming couple managed a 260 hectare property that had been a small, increasingly unviable dairy farm milking 60 cows. The family had converted the farm to a beef cattle enterprise, and had run a farm ‘bed and breakfast’ business to generate additional income. With their increasing age and declining health this family was no longer able to run the B&B and wanted to operate the farm on a low-input low-management basis. They were very uncertain about what should be done with the property in the near future, illustrated by the comment ‘... there is no future for a 70-year old working hard on the farm.’ Another farmer moved out of dairying into wool sheep production about a decade ago after severe back problems forced the farmer to change to less intensive farming. They are still keen to expand their farm business, and have recently built a ‘state of the art’ shearing shed and continue to re-fence the property. The recent drier years have allowed the m to clean out and expand the property’s dams.

A farmer working two properties of 600 hectares in the Muckleford and Clunes areas explained that a few years ago they experimented with first cross ewes and beef cattle, but found that the properties were not suited to meat production. They recently returned to a wool enterprise based on merino sheep. This farmer also tried cropping but hasn’t pursued this further after deciding that their property is ‘... too light for heavy cropping.’ Their preference is to keep the farm business with a single enterprise (wool), so it can be set up for low-input management – with specialist contractors used as required. The farm business has substantial equity (due to rising land values in the district), which has allowed them to make off-farm investments.

The variety of adaptations and underlying motivations is highlighted by another example of a farmer moving to a low-input (i.e. reduced fertilisers) but high-labour system. In this case, the sheep enterprise was focussed on lambs for meat. The farmer noted that this enterprise was returning ‘...quite good money but takes extra work.’

**Increasing water capture and efficiency**

Water availability during the growing season is a critical factor in the success of agriculture in south eastern Australia. Recent dry seasons have accentuated the importance of adequate water supplies for crops, pastures and animals. Several Muckleford farmers said they had invested in measures to increase water capture. One farmer explained that they operate a small dairy farm, growing crops such as lucerne, millet and sorghum for summer fodder. The aim was to use these crops to increase production by maximising the use of soil moisture and irrigation water. For example, deep rooted pastures such as lucerne tap into ground water and can utilise summer
rainfall. Rotational grazing is also used to maximise production from these crops. Irrigation efficiency has been enhanced by watering at night when evaporation is lower. This farmer was more focused on improving efficiency of their existing holdings rather than increasing the scale of their operation.

**Exploring alternate enterprises**

Changing climatic conditions has prompted several farmers to change their operations. Examples include:

- a farmer with a small property (40 hectares) who has changed from sheep and goat enterprises to focus on a small vineyard and winery where wine is produced for other growers. This farmer is agisting the remainder of their property to a sheep producer; and
- a couple operating a small, accredited organic dairy goat herd (milking 55 goats) on 85 hectare who make their own cheese and sell the cheese into Melbourne markets. The property is well-suited to goats, with a dominance of native grasses. Organic hay is purchased to supplement feed from the native pastures and water from the dairy shed is re-cycled/re-used.

**Technology**

Technological advances and entrepreneurial initiative have assisted some farmers to adjust to new climatic and agribusiness conditions. One interviewee was part of a family farm business with thoroughbred horse breeding and lamb production enterprises. The interviewee said that it was the effectiveness of biological control of rabbits as a result of the release of the calici virus that had enabled the family to successfully establish and grow lucerne – a high-quality feed source for the horse industry. Producing their own feed (lucerne) and developing a more efficient and mechanised process for mixing the feed had improved the profitability of the horse enterprise. The family had also accessed a reliable supply of irrigation water by negotiating access to excess groundwater from a local mine.

**Increased enterprise scale and diversity**

Other farmers are committed to maintaining a viable farming business in the long-term, despite the immediate challenges to farming. One farmer said that their farm business had evolved over the years/generations. In the last two generations, the major changes were related to pasture improvement (replacing annual with perennial species) and expanding the property size (to 2,000 hectares) by leasing land. Leasing land provided sufficient scale and diversity of soil types to successfully combine grazing (wool sheep) and cropping (mix of cereals, canola, linseed, safflower) enterprises so that the farm business was more resilient. The major changes they have made include the use of urea (nitrogen), which they rate as one of their best investments over the past 15-20 years to increase productivity, although it is getting very expensive with a narrowing margin of return. In the short-term, cropping decisions are determined by crop rotations (i.e. the cropping sequence), and available soil moisture and predicted rainfall, followed by economic outlook – although these are also linked. They remain committed to expanding the farm area to give opportunities to the next generation (they currently have a son farming with them).
4.1.4: Responses to the challenges of change by landholders in Kamarooka

Non-farmer (n=1)

There was only one non-farmer landholder interviewed in the Kamarooka district. This landholder has a long-term lease with a share-farmer who undertakes all the on-farm management. Our informant reported that the farmer had established improved pastures and lucerne. Although there are more weeds, it appears the property is more productive than a decade ago.

Farmers (n=17)

As in the Muckleford area, farmers in the Kamarooka district had adopted four strategic responses to changed conditions in recent years, including:

- increasing water capture and efficiency;
- expanding their land holdings, mostly through leasing land;
- developing products for niche markets; and
- diversifying into off-farm investments to generate income.

The major contrasts in the strategic adaptations of farmers in the two districts appears to be that some Muckleford farmers were moving towards low-input farming while Kamarooka farmers tended towards a strategy of expansion or intensification to achieve greater efficiencies. This strategic end could be achieved by buying or leasing land, increasing the area being cropped, ploughing new areas, expanding their area under lucerne: all requiring bigger machinery (buying new or leasing) and a commitment to ‘spend money to make money.’ In this way, Kamarooka farmers are using the natural productive capacities of their properties (good soil, flat terrain, large property sizes) to seek greater productivity or efficiency. This compares to the Muckleford farmers who have generally lower productivity, smaller properties on stony and hilly country with light soils, where the risk management approach is to reduce debt and shift to low input operations. In both zones, farmers have sought to diversify their income streams into off-property investments and employment. (It should be noted that by its nature, this research did not speak with the farmers who had left the land, but by interviewing existing landholders, has a tendency towards those who have been more successful in surviving the extended drought.)

There was also evidence that Kamarooka farmers were adopting some short-term or tactical responses to address changed conditions in recent years. These tactics included:

- efforts to control spending on inputs such as fuel, fertiliser, labour, equipment and water (e.g. scaling back the purchase of inputs in the short-term);
- altering the timing of lambing and shearing;
- cutting and selling failed crops as stock fodder;
- ‘dry’ sowing (ahead of the autumn/winter rainfall); and
- adopting minimum till practices (to reduce input costs, soil moisture loss and soil degradation).

Again, there were similarities and some differences with the tactical responses of farmers in the Muckleford area. The principal differences related to the increased importance of controlling input costs in the generally larger scale cropping enterprises in the Kamarooka district.
New/improved water infrastructure

As in the Muckleford district, access to reliable irrigation water markedly altered the business opportunities and on-farm management of the farmers interviewed. Farmers in the Kamarooka district who have access to reliable water supplies tended to increase the area of irrigated cropping and pastures (e.g. lucerne) and increase the scale of their beef cattle enterprises. One farmer reported that irrigation had allowed them to move from sheep into growing lucerne for hay to fatten beef cattle and cropping wheat. A substantial investment had been made to level paddocks using equipment guided by laser technology. This investment had improved irrigation effectiveness (water didn’t soak into the soil profile). However, this operation was very dependent on access to irrigation water (53% allocation at the time of the interview).

For others, accessing additional water didn’t deliver the benefits expected. In one example, a farmer and their neighbours installed bores to access groundwater but the groundwater was salty and of limited value as stock water.

Tactical responses amongst dryland farmers

Where farmers were restricted to ‘dryland’ farming (i.e. no or little access to irrigation water), then they tended to increase their investment in sheep enterprises (e.g. wool and lambs) and reduce their cattle enterprises; and increase their area of dryland cropping (often converting failed crops to hay). Several dryland farmers also reported they had altered their cropping practices, such as by moving to ‘dry’ sowing (i.e. sowing crops before the autumn break) and with minimum tillage (significantly reduced number of passes over the paddock with equipment as part of sowing crops). When cereal crops have failed, farmers have been able to cut and sell the crop as good quality hay to dairy farmers, but this option is becoming more limited as the number of dairy farmers in the region is decreasing. Some informants indicated that the area under lucerne had increased, with one farmer summing up the value of lucerne in the dry climate by saying ‘... if it wasn’t for lucerne, we wouldn’t be here. Back in the ’82 drought our paddocks were bare. That doesn’t happen now because of lucerne. All our paddocks here are under crop or lucerne.’ Reduced rainfall has prevented some farmers from planting lucerne and meant that their pastures or crops have failed to provide sufficient competition to weeds and they have spent more time and money combating weeds. Fifty per cent of one large property is cropped (direct drilling), however the increasing fertiliser costs are reducing the appeal of cropping for this farmer and the farmer is planning to lease out their cropland to a trusted neighbour and obtain off-farm employment (already arranged).

A mix of strategic and tactical responses

Three examples illustrate the mix of strategic (long-term and enduring) and tactical (short-term and temporary) adaptations being undertaken and the mix of factors underpinning these responses to changed conditions in the Kamarooka district. In the first example, a farmer has a property that is focused on sheep (self-replacing merino flock and prime lambs), with some cropping. In recent years the farmer has put in two bores and a few water troughs for stock. However, the farmer prefers dams as ‘... you always know if you have water.’ They like working with sheep and plan to continue with this enterprise. Fifty per cent of the property is now sown to perennial pasture (lucerne) and they have moved from set stocking to rotational grazing to increase meat production. They plan to undertake further pasture improvement and have
purchased direct drill equipment to do this but are unlikely to go beyond minimum tillage to zero tillage (just one pass to sow seed) because they believe that cultivation is important for effective weed control in crops.

In the second example, the farmer operates a large property (1,800 hectares) that has been expanded by leasing land (40% of the property). Cropping and merino sheep (wool) are the main on-property enterprises. They have recently cleaned out the property’s dams and have installed troughs in every paddock (from bore water, which is reliable and of reasonable quality). This family has always enjoyed working with merino sheep, but the sheep now generate about 30% of the farm’s income (compared to 60% about ten years ago). The family has adopted a range of strategies as they try to farm ‘smarter’ – with direct drilling, stubble retention and ‘dry’ sowing (sow in early-May with/without autumn break), leasing machinery and increasing the scale of their operations (leasing additional land and larger modern machinery). They also shear in July, which enables them to de-stock if conditions are dry by selling older ewes and wethers before the traditional influx of livestock to markets in October/November.

The third example is a farming family operating a property of 1,400 hectares, with cropping on 600 hectares and the remaining 800 hectares used to grow lucerne to feed 1,000 merino ewes. There is also a small irrigated dairy farm operated by a share-farmer on another block (64 hectares). With a substantially reduced irrigation water allocation they have decided not to operate the dairy next year and are contemplating selling this land (and the water entitlement) and purchasing additional ‘dry’ farmland. The family has moved to direct drilling of crops in recent years and has varied the extent of cropping and sheep numbers according to seasonal conditions. A significant strategic decision by the family was to move surplus funds into off-farm investments.

Another farmer reported they have developed an organic free-range pig farming property, and reduced the reliance on rainfall (mainly via an 18 megalitre dam), which is used for irrigating grains for on-farm animal feed. The recent dry seasons have seen crop failure and reduced water allocation for irrigation, which has made farming more difficult.

Limitations to water access have seen another farmer change from producing vealers (beef cattle) to a beef cattle stud (Charolais). The cattle are raised on largely dryland lucerne. While they have an irrigation right (a channel runs along the back of the property), during the last 4-5 years they haven’t had any allocation. In the past they have flood irrigated some lucerne, and have recently laser levelled some paddocks and established more lucerne. Cattle can graze for 10-12 years before the lucerne needs to be resowed. They crop wheat and oats, and harvest hay for their own use. The declining availability of water and trading of irrigation water out of the district has had a big impact on the local community.

Another farmer appears to have adapted to drier conditions and continued to have a viable business, as they have developed an intensive poultry business over the past decade (their main enterprise), but also run some sheep and grow some oaten hay – with 500 ewes (for lambs), 240 hectares of crop and the poultry. Previously, the family has run cattle and more sheep on the property. They have established lucerne paddocks since 1999, giving them better pastures than previously, saying they are ‘...trying to keep up with the changes in agriculture – we want to do at least 80% of what the top farmers do.’ Poultry remains their business priority, then the cropping and sheep (lambs). They’re always looking to improve production and achieve greater...
efficiencies with inputs, and so are more willing to get contractors as needed these days. They are used to the drought, but have doubled the size of their dams. They have also bought some grain feeders and haven’t been over-stocked – with the lucerne important in achieving this.

Adaptations by farmers and non-farmers in Muckleford and Kamarooka are summarised in Table 2 and Table 3.

Table 2: On-farm changes made by landholders in Muckleford and Kamarooka

<table>
<thead>
<tr>
<th>Changes by landholders in Muckleford (N = 18)</th>
<th>Changes by landholders in Kamarooka (N = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increase water capture (bores for groundwater, clean-out &amp; expand dams) and water efficiency (install pipes &amp; troughs, recycle).</td>
<td></td>
</tr>
<tr>
<td>• Develop low-input &amp; low-management farming systems (increase in sheep for wool +/- meat, reduce cattle) to reduce financial risk, improve ecological sustainability &amp; match lifestyle preference (reduce workload on farm, willing to use contractors).</td>
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<tr>
<td>• Increase area of lucerne (deep-rooted perennial pasture for grazing +/- hay).</td>
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<tr>
<td>• Develop products for niche markets that are suited to dry conditions &amp; pastures (e.g. milking goats, wine grapes, native seeds).</td>
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<tr>
<td>• Reduce revegetation of native plants and encourage natural regeneration.</td>
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<tr>
<td>• Increase weed control (greater prevalence of weeds in district).</td>
<td></td>
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<tr>
<td>• Lease land to neighbouring farmers.</td>
<td></td>
</tr>
<tr>
<td>• Increase water capture (bores for groundwater, clean-out &amp; expand dams) and water efficiency (install pipes &amp; troughs, recycle).</td>
<td></td>
</tr>
<tr>
<td>• Refine farm business (e.g. analyse value of purchasing fertilisers &amp; water, alter timing of lambing &amp; shearing, timing of cropping, reduce labour, use contractors, lease machinery, develop niche markets – organic pig meat).</td>
<td></td>
</tr>
<tr>
<td>• If access to reliable &amp; sufficient water, increase irrigated cropping and pastures (e.g. lucerne), and increase beef cattle.</td>
<td></td>
</tr>
<tr>
<td>• If dryland farming (i.e. no/little access to irrigation water), then increase sheep (wool &amp; lambs) and reduce cattle, and increase dryland cropping (convert failed crops to hay).</td>
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<tr>
<td>• Increase area of lucerne (deep-rooted perennial pasture for grazing +/- hay).</td>
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</tr>
<tr>
<td>• Alter cropping practices (e.g. increase in ‘dry’ sowing &amp; minimum tillage).</td>
<td></td>
</tr>
<tr>
<td>• Expand farm area by leasing (land prices increasingly above perceived agronomic potential).</td>
<td></td>
</tr>
<tr>
<td>• Increase off-farm investments (assumed to be non-farming investments).</td>
<td></td>
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<tr>
<td>• Reduce revegetation of native plants.</td>
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</tbody>
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Table 3: On-farm changes made by landholders

<table>
<thead>
<tr>
<th>Changes by farmers (N = 30)</th>
<th>Changes by non-farmers (N = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(13 = Muckleford, 16 = Kamarooka)</td>
<td>(5 = Muckleford, 1 = Kamarooka)</td>
</tr>
<tr>
<td><strong>Muckleford</strong></td>
<td><strong>Muckleford</strong></td>
</tr>
<tr>
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<tr>
<td>• Develop low-input &amp; low-management farming systems (increase in sheep for wool +/- meat, reduce cattle) to reduce financial risk, improve ecological sustainability &amp; match lifestyle preference (reduce workload on farm, willing to use contractors).</td>
<td>• Reduce livestock (often, removing all livestock permanently).</td>
</tr>
<tr>
<td>• Increase area of lucerne (deep-rooted perennial pasture for grazing +/- hay).</td>
<td>• Reduce revegetation of native plants and encourage natural regeneration.</td>
</tr>
<tr>
<td>• Develop products for niche markets that are suited to dry conditions &amp; pastures (e.g. milking goats, wine grapes, native seeds).</td>
<td>• Increase weed control (greater prevalence of weeds in district).</td>
</tr>
<tr>
<td>• Reduce revegetation of native plants.</td>
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</tr>
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<td>• Increase weed control (greater prevalence of weeds in district).</td>
<td></td>
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<tr>
<td><strong>Kamarooka</strong></td>
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</tr>
<tr>
<td>• Increase water capture (bores for groundwater, clean-out &amp; expand dams) and efficiency (pipes &amp; troughs, recycle).</td>
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4.2: Research Question 2: Are adaptations by private landholders consistent with NRM practices recommended by agencies?

All interviews explored landholder attitudes, values and management of native remnant vegetation. In presenting the findings from our analysis of interview data we first provide an overview of key findings for each topic, then a comparison of landholder management against a set of ‘best practices’ for regional NRM. Again, we present information for each zone separately.

4.2.1: Perspectives on native vegetation from Kamarooka landholders

Nature of native vegetation

Most informants in the Kamarooka zone recognised remnant vegetation on their properties. Informants typically identified standing trees, though a smaller number also discussed native grasslands separate to their treed areas. Only a couple of informants described their remnant vegetation in terms of a system of trees, understorey and grasses.

Value of native vegetation

A small number of informants valued native grasses as providing stock feed in dry times, though this generally seemed to relate to grasses growing in wet areas that had not been cropped, or along creeklines associated with trees. More commonly, native grasses seemed to be in conflict with other land uses. For example, respondents said native grasses needed to be controlled in cropping areas and that much higher productivity could be gained by grazing stock on improved pastures, particularly lucerne.

A wide variety of values were expressed for remnant trees, with some values repeated by numerous informants. Most informants highlighted the ‘utility’ values of trees as shelter for livestock (wind and shade) and as habitat for beneficial birds and insects that helped in the control of pests, thereby reducing the need for applying expensive chemical sprays. Native trees were also seen as an important part of effective weed control strategies on roadsides and areas of the property not actively farmed. Many informants mentioned the biodiversity value of trees (both remnant and planted), but this value was often connected to the pest control function of birds and insects rather than other values of biodiversity, such as existence value.

A number of informants held strong views about the importance of managing weeds and pest animals and these views could be in conflict with remnant vegetation protection. One example was where a landholder wanted sufficient space to operate a boom spray in treed areas so they could control weeds. Another example was a perceived conflict between brolgas and ‘bushes’ where the landholder believed that promoting bush regeneration would provide habitat for foxes which would then kill the brolgas. ‘We have brolgas here. I said to the greenie fella, (from CMA) just get rid of the foxes. You need to get rid of their habitat, get rid of the lignum bushes – what does he want, bushes or brolgas?’

The beauty or aesthetic value of trees and a treed landscape was often mentioned, though for some, this could also be related to improved property values. However, some informants expressed more personal and intrinsic values, including the value of wildlife coming back onto their property. Informants said they had planted vegetation
specifically to establish wildlife corridors and one informant had constructed bird hides to better observe birdlife. Others explained the pleasure they derived from conserving their remnant bush: ‘Just for the pleasure of seeing it, and it is the right thing to do.’ As one informant said: ‘You’ve gotta preserve it. It would look ordinary without it. I like bigger trees, for their aesthetic appeal.’

There was also evidence of a stewardship ethic in the comments of some landholders. That is, landholders were focussed on improving the long-term health of their remnants. As one informant said, they had an obligation to ‘leave the property in better shape than we found it.’

One informant talked about their desire to be carbon neutral and the important role of trees as carbon sinks. This informant thought there was some potential to obtain carbon credits by planting trees.

While some informants spoke about the potential of farm forestry as an alternative land use, only a couple of informants had planted trees as farm forestry blocks. These landholders were members of the Northern United Farm Forestry group, and both said farm forestry was more a hobby than a commercial enterprise. One member valued the social interaction resulting from group membership, noting that the diverse participants in the group made meetings more interesting than those of the local Landcare group.

Beliefs and attitudes towards native vegetation

Some informants expressed negative attitudes about the value of remnant vegetation and replanting natives. In part, this reflected a conflict between production and conservation values. For example, some people said that protecting grasslands or planting trees removes land from productive use. One person summed up the dilemma between conflicting values with the statement that ‘We could plant 10% of the farm, but we could still be zero biodiversity, because the sprays kill everything. If you have canola, you can’t have biodiversity. It is too valuable, so you have to spray. We would need to change our management practices to achieve the best outcomes (for biodiversity).’

One person believed that there were now more trees in the landscape than ever before. As a result, this person thought Australians had ‘wasted a lot of money on tree planting.’

Another informant thought that landholders were unfairly expected to carry the economic burden for biodiversity conservation. In this person’s view, ‘… farmers are made to do too much to protect native vegetation. If the government wants to protect native vegetation, they should buy and manage these areas.’ As another landholder said, ‘Planting trees is very expensive …’

Management practices

There were considerable differences in the management of native remnants and plantings amongst our informants in Kamarooka. It seems that paddock trees are rarely actively managed or fenced to manage stock access. Not surprisingly, most tree paddocks were not regenerating. Indeed, there were comments about tree paddocks dying.

On the other hand, informants said that many of the remnants along creeks were fenced to manage stock access, as were tree plantings. However, it seems that remnants along creeks and gullies are regularly grazed. As one informant explained,
‘This has been happening for 120 years, and the vegetation is still there!’ Another informant believed that ‘… grazing management (i.e. a grazing regime, not exclusion) is the key to retaining natives.’ Some informants said they were not actively managing their remnants (e.g. spraying weeds, removing willows), while others were doing their best to protect and enhance vegetation in these areas.

Remnant grasslands appear to be under greater pressure than remnant trees. In the past, long rotations between crops and limited application of chemicals to control weeds meant that some areas of native grasses survived. Today there is increased pressure to maximise productivity and the benefits of lucerne as a deep-rooted, high value pasture or hay is widely recognised. As one informant explained, ‘The economic benefits of lucerne are huge.’ Another informant was more explicit when they said they try to ‘minimise the native vegetation, get rid of the native grasses’ in their cropping country. As a result, native grassland are now being cropped or sown down to lucerne.

Some landholders reported planting large numbers of trees in the past, using a variety of methods from planting tubestock to direct seeding and fencing to control stock access and allow for natural regeneration. Variable results had been achieved from these methods, with low success rates in recent dry years, particularly for direct seeding. A couple of people said they might return to planting seedlings. With the ongoing dry seasons, informants thought that there was little revegetation occurring.

Future plans for remnant vegetation management included planting more trees, linking smaller areas of remnant vegetation through additional plantings, fencing and revegetating salty areas, fencing areas for natural regeneration, and engaging with programs such as ‘Bush Tender’ to support landholder management of remnants.

Factors influencing vegetation management

As is obvious from the preceding discussion, our informants identified a number of factors influencing their management of native vegetation. Other factors will be discussed in subsequent paragraphs. These factors can be seen as either drivers or constraints on actions, and can be classified further as those related to personal characteristics, the wider social/economic context or the nature of the technology [Figure 1]. The influence of beliefs, values and attitudes, highlights the importance of landholder characteristics on the adoption of conservation behaviours. Attributes of practices (perceived costs and benefits) are also important influences on behaviour. As explained, the costs of active management include the loss of potentially productive land and the expense of planting and fencing. Management decisions and behaviours reflect the interaction between these sets of factors.

Managing remnants and planting trees is not generally seen as a ‘productive’ farm activity, so these activities have to be fitted in around the normal activities of running on-property enterprises. For some of our informants, time (and the opportunity cost of their time/labour) was a significant obstacle to planting, fencing and active management of remnant. Concerns about the labour required for on-going management was also an issue for those contemplating farm forestry (e.g. the time required to thin and prune trees). Some informants were also concerned about the time and expense of maintaining fences around tree plantings or remnants.

Factors that relate to the external operating environment facing agriculture were also identified from our analysis of interview notes. Recent climatic and economic conditions are two examples of external influences on property management affecting
vegetation management. For example, the need for increased productivity to cope with increased input costs has been an important influence on the expansion of cropping and lucerne, and the subsequent loss of native grasslands. The ongoing drought has also resulted in a reduction (or deferral) of planting programs, as outlined above.

Government policies and programs were raised as both drivers and constraints (disincentives) for planting/retaining native vegetation. One informant provided an example where landholders ploughed native grasslands ahead of an unpopular law being proclaimed that would require a full biological assessment for ‘significant’ native vegetation on land not cropped for the previous ten years prior to a permit for cropping being issued. As this person said: ‘I know of several ‘best quality’ areas burned and ploughed within days of the regulation becoming known. This was just because people didn’t want some bureaucrat telling them what to do!’

Informants provide a number of examples where their relationships with agency and project staff had both positive and negative impacts on their participation in revegetation activities. For example, cash grants, the provision of materials and access to information through Landcare groups and the CMA had been positive influences on decisions to plant trees and erect fences to manage stock access to remnants. Others said that the proportion of costs provided by CMA programs was inadequate. Others said that inflexible guidelines had been a barrier to their participation in programs and had constrained the scale of their on-ground revegetation work. As one informant explained, the CMA is constrained by its priorities:

‘The CMA is heavily focused on salt and streams. We haven’t got either in this area. They chuck in huge amounts of money – if you have salt or streams, they pay the full costs of fencing, they throw money at you. If I want to fence my remnants, I can’t get anything. They come and drool over my remnants and tell me I need to protect them, but where is the support. I am frustrated.’

Another informant said that:

‘The CMA requires 30m wide plantings. We won’t be doing that. For a 1km long planting, we don’t mind doing 15 m wide, but not 30 m, that is too wide. So, we end up doing less, but doing it all ourselves.’

Another landholder disagreed with the CMA over what to plant:

‘This is what they want – whipsticky stuff, all small wattles, after a few years, they are stuffed. We have different perspectives on what should be planted. They won’t negotiate on what they will fund. … They wanted to put in wattles, but they get wet feet, and wouldn’t last.’

The final external factor identified, the influence of outside societal expectations, was raised by one informant explaining why agroforestry was an unattractive option. As this informant explained, ‘The greenies won’t let agroforestry timber be harvested.’

4.2.2: Perspectives on native vegetation from Muckleford landholders

Nature of native vegetation

With one exception, all informants in the Muckleford zone said they had remnant vegetation on their property. The exception was an informant who operated a commercial orchard. Some informants had a detailed knowledge of their remnants;
identifying individual species, describing the mix of trees, shrubs and grasses and explaining the wildlife habitat value of vegetation. A couple of informants had a much lower level of knowledge and interest in remnant vegetation, one simply acknowledging that they had some areas of bush on their property. Informants described remnants along creeklines (remnants along Jim Crow Creek seemed particularly highly valued by landholders), paddock trees (though these were often described as being old, drought stressed or dying), and in the hill country. Hill country was often described as dry or stony, with low productivity, sometimes as not being cleared for farming and thus containing remnant vegetation. Others talked about destocking this low productivity land and allowing for regeneration of native vegetation to occur. A number of informants had purchased parcels of land specifically because of the quality of remnant bush on the property, or to regenerate degraded land. Areas of native grasslands were also identified, mostly as being in the lower productivity hill country. As one informant explained, this was because ‘A lot of it (hill country) you can’t improve, other than by dropping something from the sky.’

Value of native vegetation

Some informants spoke about the utility/production value of remnants, such as providing shelter for livestock and as providing habitat for birds that help control crop pests. However, these values were rarely discussed and were secondary to a range of non-use values, including maintaining species diversity and nurturing the degraded landscape back to health. As one informant explained, ‘The biodiversity on this farm is spectacular. We have a rich diversity of fauna, including gliders, phascogales and owls.’ A small number of informants also recognised the potential environmental and economic benefits of native vegetation as a sink for carbon and as a source of income from carbon credits for sequestering carbon.

One informant spoke of their belief that sheep were destroying the landscape and their desire to be the ‘caretaker’ of closed areas of native bush. Another informant spoke of the need to work with nature when farming: ‘I am an old-fashioned conservationist. I’m not a greenie. You have to work with nature but consider the economic fact that you have to produce something. You have to put back in.’

Most informants agreed that there is little production value in farming some hillsides, and that these areas and their slopes should be fenced and revegetated, or allowed to regenerate. As one sheep farmer noted: ‘The land up there is very rocky and dry and productive capacity is very low. I’m better off putting trees up there. It’s a natural thing to do growing trees; it’s an aesthetic thing.’ At the same time, some landholders valued these areas for their native grasses that survive dry times and respond to summer rainfall and provide good fodder for grazing animals.

The potential for conflicting values was raised in relation to the effects of kangaroos on tree seedling survival during the drought. One non-farmer who had purchased an overgrazed and stressed property described how they were seeking to ‘nurture the property back to health’ by planting thousands of trees and shrubs. This person had signed a conservation covenant that required stock to be excluded from the property for ten years. Despite their environmental values, they had become so frustrated by the impact of kangaroos on the survival of seedlings that they had applied for a permit to cull kangaroos.

Another informant spoke of the tension they felt between looking after the health of the land and the need to generate an income from the land, particularly in relation to
competition for limited soil moisture. ‘They try and tell you to plant shrubs, but the big trees are too stressed to share the (subsoil) moisture... Once you’ve done (planted) some areas, you can’t keep fencing off areas – how do you make any money? Until we get some subsoil moisture, what’s the point of planting trees?’

**Management practices**

Planting and then fencing to exclude stock, particularly from creeklines and erodible hillsides, was the most common approach to managing remnant vegetation in the Muckleford zone. A small number of informants said that they continued to graze native grasslands as this was the best way to manage these areas. Some informants expressed a preference for direct seeding over planting seedlings, and some said they collected seed from their property and roadsides.

The combined effect of a run of dry years and increased grazing by native animals had resulted in lower survival rates for seedlings. A few informants said they had fenced to exclude kangaroos from remnants and two informants discussed culling as a way to reduce kangaroo predation on seedlings. One informant had started a culling program and another had applied for a permit to cull. Some informants said they had changed from planting (seedlings or direct seeding) to allowing the land to regenerate naturally. This approach allowed nature to select which species and individual plants would survive.

Weed control was mentioned by a number of informants as an important aspect of managing native vegetation. Covenants were also seen by some informants as a means to control future land use practices, with both CMA and Trust for Nature covenants being taken out (one landholder’s application for a Trust for Nature covenant was rejected because the land was too weedy).

Some informants felt that they had done enough and would not increase the area under native vegetation. However, most informants said they wanted to expand the area under native vegetation. Informants specifically wanted to protect and replace dying paddock trees and plant more trees to control erosion. Future plans largely represented an extension of existing management approaches. Those talking about changing practices were considering improved species selection, planting at times to optimise survival rates, changing from planting to direct seeding or natural regeneration and excluding stock completely from hill country and creeklines.

**Influencing factors**

Data from the Muckleford interviews highlighted the importance of the personal attributes of landholders (values and attitudes) as a set of factors influencing landholder management of remnant vegetation. As explained above, revegetation, regeneration, fencing to manage stock access and efforts to control pest animals and weeds were all consistent with the strong environmental values of informants.

Resource access, particularly funds to pay for tubestock, was identified as a constraint affecting informants’ capacity to undertake revegetation work. On a positive note, the support provided by agencies and other organisations, including access to information and funds, as well as the opportunities for social interaction, were important in assisting improved management of remnants.

The most often mentioned external factors affecting revegetation decisions were drought (see above) and the support provided by government and other organisations. The CMA and Landcare groups were identified as organisations providing valuable
information, materials and funds to support fencing and planting programs. Other organisations mentioned were Trust for Nature (which also provides a mechanism to influence future management), a biological farmers group (without the support of which one landholder said ‘I don’t know if we could farm here’), the Box Ironbark Farm Forestry Network and the Living Landscapes Program (a joint DSE/CMA initiative).

Regulations were also mentioned by two informants, one in relation to organic certification (requiring 20% of the property to be fenced out from stock), the other in relation to the need for stronger regulations from the CMA to manage Jim Crow Creek. Finally, carbon credits were mentioned a few times as a potential incentive to increase the area of native vegetation in the future.

4.2.3: Comparison of responses from Kamarooka and Muckleford zones

While there are similarities in the responses of some landholders, there are also substantial differences between the two zones in how native vegetation is perceived and managed. Our informants in the Muckleford zone were more committed to active, ongoing management of native vegetation than our informants in the Kamarooka zone. Interview data suggests that differences in the values and occupations of landholders and differences in the physical environments of the two zones are important factors explaining differences in approaches to management of native vegetation.

The Muckleford zone has a more complex and hilly landscape that is less suited to profitable cropping than the more open plains landscape of the Kamarooka zone. The Muckleford zone is also closer to Melbourne and areas of denser settlement. Not surprisingly, Muckleford has been settled by a substantial proportion of non-farmers whereas farming continues to be the principal occupation of most landholders in the Kamarooka zone. Again it is not surprising that the values of informants in the two zones were very different. Muckleford informants had a stronger orientation towards conservation and were more likely to value remnants for their intrinsic and conservation or non-use values rather than their utility values. Kamarooka informants had a stronger production orientation and were more likely to value remnants for their utility values. For example, Muckleford informants were more likely than Kamarooka informants to value remnant vegetation for its roles in the conservation of species and restoring degraded landscapes while Kamarooka informants were more likely than Muckleford informants to value remnant vegetation for its role in providing shelter for stock or habitat for beneficial insects that controlled crop pests. These values were in turn reflected in different behaviours. For example, some Muckleford informants were involved in de-stocking and revegetating/regenerating hillsides whereas some Kamarooka informants were replacing native grasses with crops or lucerne.

In both zones, it was the areas of less productive land that were identified for revegetation (or as retaining remnant vegetation). In the Kamarooka zone, this was generally low lying land, too wet or salty for cropping. In the Muckleford zone, the low productivity land was typically the dry rocky hills with poor soils and limited capacity for pasture improvement. In both areas, remnant vegetation is also found along creeklines, and those areas are being fenced to manage stock access and encourage regeneration.

Drought is an important factor influencing land management in both zones. Drought has resulted in poor survival rates for revegetation programs, and something of a
hiatus in planting, including through Landcare groups. In the Kamarooka zone, the combination of drought and the cost/price squeeze has driven farmers to seek greater productivity by intensifying their activities, including through the expansion of profitable cropping enterprises and establishing lucerne pastures. The expansion of cropping and lucerne has come at the cost of some remnant grasslands. In the Muckleford area, ongoing drought conditions have emphasised the low productivity of the dry hill country and been an important stimulus for destocking and revegetating those areas.

Labour availability was identified as an important constraint for farming enterprises in the Kamarooka zone, including for work to enhance the extent and condition of native vegetation. Labour may be an issue for Muckleford landholders but this issue was not raised in our interviews.

Informants in both zones discussed their relationships with other organisations and the impact of these organisations on their management decisions and practices. Information, advice, and the provision of materials and labour or cash to purchase these inputs were all considered important elements of efforts to effectively engage landholders. For Muckleford informants it was information, advice and support that were important rather than cash or labour, whereas in the Kamarooka zone, materials and labour were the more critical ingredients. Again, these differences are consistent with the differences in values and occupations described above.

4.2.4: To what extent are adaptations by private landholders consistent with NRM practices recommended by agencies?

To conclude this section, we briefly consider the extent that the adaptations described above are consistent with best-practice management of native vegetation. In doing this we have drawn on the recommended practices for enhancing remnant native vegetation on private farmland identified by Hamilton (2001) [See Box 2]. An additional practice would be strategic planting or regeneration to create larger areas of remnants that link smaller areas to create wildlife corridors and reduce “edge” effects on native vegetation (Davies et al. 2001).

**Box 2: Recommended practices for enhancing remnant native vegetation on farmland**

- Control grazing by livestock in remnants;
- Minimise cultivation in/near remnants;
- Control pest animals and weeds in remnants;
- Leave native vegetation debris in-situ;
- Stimulate regeneration of native plants (e.g. strategic use of fire, grazing); and
- Enrichment planting (e.g. establishing understorey vegetation).

**Note:** Enhancing the quality of remnant native vegetation will need an approach that is tailored to a site’s specific characteristics.

**Source:** Adapted from Hamilton 2001.

Informants from both case study areas placed a high value on remnant vegetation and were engaged in or had undertaken a range of actions to enhance the extent and/or condition of native vegetation on their properties. These activities included most of
the practices identified by Hamilton (2001). Drought conditions were identified as an important constraint on these activities, particularly amongst farmers in the Kamarooka zone. There was a high level of concern about the declining condition of paddock trees and a desire for information and assistance about how to retain this important landscape element amongst landholders in both case studies.

Despite the apparent general commitment to better management of native vegetation there were examples, particularly in the Kamarooka zone, where management practices were inconsistent with those identified by Hamilton (2001). For example, many informants in the Kamarooka zone had cultivated additional land for cropping or to establish lucerne. The impact of these actions is likely to be a substantial, if unquantified loss of native grasslands. There was also evidence that Kamarooka informants were grazing remnants that had been fenced to manage stock access. In some instances these landholders were grazing areas that had not been grazed for many years. In other instances landholders were grazing more frequently than in the past. The impact of grazing these areas is unknown. Concerns about pest plants and animals in remnant vegetation meant that some landholders were “tidying-up” these areas to remove harbour for feral animals and to bring spray equipment in to manage weeds. Actions to control pest animals and weeds are consistent with Hamilton’s (2001) best-practice management but not if those actions involve increased cultivation (to reduce weeds) or removing debris (pest animal harbour).

Efforts to address conflicts between current and best-practice management of remnants will be difficult given the actions of landholders are largely driven by forces outside the influence of NRM agencies; i.e. drought and the imperative of the cost/price squeeze on farmers. One option is to assess the extent of likely impacts and if those impacts are considered to be substantive, invoke the regulations that exist to protect remnants, particularly native grasslands. Given past experience, and the comments of our informants, such an approach is unlikely to be effective unless complemented by other approaches, including the investment of substantial funding to demonstrate that government is prepared to share the costs of management actions that conserve habitat.

### 4.3: Research Question 3: How important is climate variability as a factor contributing to enterprise/land management decisions?

The point has been made that landholder decision making is influenced by a complex web of interacting factors. As explained in the background section and in our companion literature review (Mazur et al. 2008), there are theoretical frameworks that assist those attempting to make sense of this complexity, including in a climate change context. In Figure 1 we have identified four broad sets of factors affecting landholder decision making: personal attributes; the range of resources (social, human, financial, physical) available; the external operating environment; and the nature of the practice or technology under consideration. As has been highlighted in our review of the literature (and already noted in Section 4.1.2 of this report) a distinction has also been made between strategic and tactical adaptations to climate change, depending on whether the adaptations are long term and enduring, or short term and temporary. In this section we begin by attempting to explain the range of factors affecting enterprise/land management decisions. We then explore our
informant’s beliefs and understanding of climate change before attempting to assess the relative importance of climate variability as an influence on decision making.

4.3.1 Factors contributing to landholder enterprise/land management decisions

Some factors are likely to influence the decision making of all landholders. Market forces or climatic variability would be examples of factors affecting all/most landholders. However, some influences are specific to particular individuals. For example, each person has a specific set of values, attitudes and beliefs and these attributes will influence their management decisions. The different attributes of individuals and their varying levels of resource access (e.g. finance, infrastructure, plant and equipment, soil types) will mediate the influence of external stimuli and increase the complexity of responses by landholders across a district such as Kamarooka or Muckleford.

The following material discusses the more prominent factors found to be influencing property management decisions amongst Kamarooka and Muckleford informants. Individual factors can be related back to the four broad factor sets mentioned above and the decision making model [Figure 1], but taken together, they highlight the complexity of decision making and the inter-dependence and interaction of the factors. Figure 4 illustrates some of this complexity in the factors influencing enterprise and land management decisions.

Climate

Much of the discussion of climate and climate variability focussed on the ongoing ‘drought’ where significantly lower rainfall had been experienced for more than a decade. Climatic conditions affected the land management decisions of all informants but to varying degrees.

As explained in earlier sections of the report, there has been a range of responses to drought in Muckleford and Kamarooka [Figure 4]. The range of adaptations to drought include improving the efficiency of water storage and delivery infrastructure (cleaning out and expanding dams, installing tanks, pipes and troughs); sourcing new supplies of water (bores and wells); conserving soil moisture (minimum till techniques such as direct drilling and spraying weeds in summer); making more effective use of limited water supplies (deep rooted perennial pastures such as lucerne); changing crop types or varieties; reducing the area of crop or not cropping; cutting hay from failed crops; changing from cattle to sheep; and working and investing surplus cash off-farm.

Drought had also changed attitudes about the preferred methods of planting native trees particularly in the Muckleford zone where revegetation was generally a higher priority. Informants also expressed concerns about the negative impact of wildlife on horticulture crops (lorikeets in the orchard) and on revegetation success (kangaroos and wallabies) as a result of drought. Some landholders in the Kamarooka area had put stock into previously ungrazed wetland areas and had cultivated areas of native grasslands that had previously been too wet to crop.
Figure 4: Some interactions between factors influencing enterprise and land management decisions
Drought was also affecting the emotional well-being of individuals and groups in both case study areas. There was evidence of drought stress leading to depression. On-farm adaptations seemed to enable most informants in the Kamarooka zone to remain positive about their capacity to respond to drought, some even spoke about the drought bringing their community closer together. Muckleford informants were more likely to highlight the negative impacts of drought such as failed crops resulting in a depressed local economy. Some informants in the Muckleford zone thought that drought was a major contributor to the social changes occurring in their district, with farmers leaving the land to be replaced by ‘weekenders’ or ‘lifestyle’ residents. The harsh reality of drought was also confronting for these ‘lifestyle’ landholders and some felt their commitment to rural life was waning.

A small number of informants mentioned the impact of aspects of climate other than drought on their management decisions. These informants identified the influence of trends to warmer conditions and changes in seasonal rainfall patterns. For example, with warmer temperatures crops such as grapes are maturing earlier and quality is being compromised by more rapid ripening. Reduced winter and spring rainfall has resulted in poor crops and a shorter growing season for ‘traditional’ pastures including clover. As one informant explained, ‘The rain is not falling in the growing season...there is a very low return from grain.’ On the other hand, deep rooted perennials such as lucerne were able to provide better return from limited rainfall, and better utilise increased summer rainfall. While lucerne has been around for decades, some farmers have expanded their area of lucerne in recent years.

‘We have been planting more lucerne to adapt to changing rainfall.’

‘Wetter summers has helped to extend the season for lucerne.’

‘Lucerne is very important to us. Even over the dry times the lucerne just keeps growing, it’s amazing what you can get off it...’

The links between ‘drought’ and response or adaptation can also be plotted in an ‘influence diagram’, to show how different individuals might follow alternative pathways that lead to quite different sets of outcomes. While many potential factors have been identified in Figure 5 for the Kamarooka and Muckleford zones, Figure 6 focuses on a single decision – the decision to plant or expand the area of lucerne – and its implication for property management. Our research has found that this decision is important in contributing to the direction that a property takes in response to drought. The decision to plant or expand the area of lucerne may be governed by land capability (soils, terrain, property size etc.), but also by individual characteristics such as personal preference or perceptions of and aversion to risk, and access to resources (financial, farm machinery, labour). Figure 6 highlights the difference between a move towards low input/management systems (lower perceived risk) compared to a move towards an expansion or intensification of farm activities discussed in Section 4.1. Drawing on the discussion in Section 4.2, the figure also highlights the potential outcomes for native grassland. The expansion of lucerne can lead to a loss of native grassland, as has been indicated in the Kamarooka interviews (area B in Figure 6) whereas in the Muckleford zone, land capability was more likely to not support the establishment of lucerne, and the lower productivity areas of the farm have been kept as native grasslands and in some cases destocked in response to the drought (area C in Figure 6).
Figure 5: Examples of landholder responses to ‘drought’
Drought

Reduced crop productivity

Reduced pasture productivity

Increased feed costs

Expand area of lucerne

Increase pasture productivity

Reduce stocking rate

Increase stocking rate

Protect native grassland

Loss of native grassland

Shift out of dairy

Reduced water allocation

Increased water prices

Figure 6: Influence of drought on landholder decisions regarding lucerne establishment and resultant impact on native grassland
Water

Water allocation, water pricing and water trading were identified by informants as factors driving adaptations. As one orchardist indicated, ‘You can’t get bigger without extra water allocation.’ Water rights are tradeable both on a permanent or temporary (seasonal) basis. The temporary transfer of rights can be seen as an opportunistic or tactical response to the operating environment at any time. The sale of a permanent water right is, however a strategic action with long-term implications. In some cases, informants said that water rights were more valuable than the land they owned and that permanent water sales had resulted in farmers exiting agriculture. Again, this view was highlighted by an informant who said ‘I used to think of my water allocation as integral to the farm, but I now consider it as more of an asset.’ The increased price of temporary water was one of the obvious outcomes of drought and reduced irrigation allocations. As one farmer in the Kamarooka zone explained, ‘It is better to sell (water) at $1000 per megalitre.’ This farmer made a strategic decision to move out of irrigating summer pasture for dairy cows to growing dryland grain crops to feed cattle and sheep. However, they had not sold their permanent water rights and to some extent were keeping their future options open.

Some landholders said they would not sell water permanently. They also thought that water trading that resulted in the net sale of water out of their district would have negative social and economic impacts for the district. As one informant said, ‘I wouldn’t sell a drop of my water, I need it all. The selling of water has ruined the Goulburn valley.’ Another explained, ‘Water trading is forcing dairy farmers off their farms. Water is being bought by investors down river, for new plantations. Old orchards are dying, they can’t afford the money for water – investment companies are putting in fruit trees and olives in the middle of nowhere.’ Another informant said that ‘Water allocation used to be tied to the land … water is being traded away and out of the community … the price makes it attractive to sell, some have got out of farming and the blocks just deteriorate … then you get the ‘hobby farmers’ coming out – they are not people who contribute to the community.’

Not all informants had negative views about water trading. Some said they might buy more water if they could get it at a reasonable price. Some also saw water as a commodity that could be traded according to prevailing environmental and market conditions. For others, selling water has provided a source of capital that has enable them to get off the land. For others, it represents increased capacity to expand their enterprise scale by purchasing land with no attached water right (and thus at a lower cost). One informant saw both sides of the water trading issue. With two business partners, this informant had expanded the farming enterprise over a number of years to owning and leasing a number of properties. ‘Water trading has been a big change to farming. I think the government acted too early on this issue without all the background. However this has opened up opportunities for us to purchase more land.’

An interesting response to drier conditions occurred when a group of Muckleford landholders negotiated with a mining company to pipe waste water from a mine to their properties. As one informant suggested, ‘There has been a change in people since they have had water. It is life altering to have access to water again.’

Economic issues

A large range of economic issues influence landholder enterprise/management decisions in the Kamarooka and Muckleford zones. Most of these economic issues are
a product of the external operating environment, but some relate to individual attributes and access to resources.

**Market prices**

Many farmers respond opportunistically to changing market conditions. For example, if the price of wheat falls compared to the price paid for other crops that can be grown in similar conditions, farmers will typically respond by sowing less wheat and increased areas of substitute crops such as canola.

The Kamarooka zone is much more suited to cropping than Muckleford where properties are smaller and generally on more hilly terrain with rocky or light soils. Whereas all informants in Kamarooka were cropping some part of their property, only a small proportion of Muckleford informants were producing annual crops. Perennial crops such as grapes and apples were more common amongst the informants in the Muckleford zone. With a variety of annual cropping options, including wheat, oats, barley, canola lupins, peas, safflower, linseed and lucerne for hay and silage, Kamarooka landholders had greater capacity to respond quickly to changes in market prices and input costs or climatic conditions. As one informant explained, this flexibility was critical to profitable agriculture.

'I don’t feel like we’ve been forced into anything. We react to those things as we go. That’s a frustration of the job, you can plan ahead to some degree but you are very much reactive all the time... that’s the dry ten years. We’ve made a profit every year and we manage to keep trading profitably. We can manage around whatever comes our way.'

Decision about the mix of crops grown also involves complex assessments about the mix of risks and rewards of different cropping options.

'We could increase the amount of canola, this is a bit riskier on the grain front. More expense, more risk. At least we can cut for hay now which reduces the risk. This year I sold canola hay for silage. I try to keep as much cereal in the rotation as possible, this is less risky.'

The changing wool market was highlighted by a number of informants as a key factor affecting decisions about their enterprise mix. Most of these informants had shifted away from merino wool to first cross ewes and lamb production, thus diversifying their business into both meat as well as wool.

'We used to have a merino flock. This was all about wool. Then we went into breeding our own first cross ewes. Now we buy first cross ewes, because this is a lot less work. ... The main thing in merinos is for wool. The price is down at the moment, and merinos are hard to look after. Cross breeds are easier to look after, you get the wool, but you also get the fat lambs out of them. So, we’ve gone out of merino.'

Despite the general trend out of sheep for wool, one informant in the Muckleford zone had moved from sheep for meat to a wool focus. ‘The property is all sheep now, and the sheep enterprise is all wool. We tried first cross ewes a few years ago, but now the wool price is good. I reckon merinos are more suited to this hill country.’ Other reasons to move out of sheep for wool enterprises included the amount of work to look after sheep and the intention to have a diversity of income streams.
**Input prices**

Profitability is influenced as much by input costs as by prices paid for outputs. Our informants reported increased prices for most inputs, including feed for livestock, irrigation water, fertilisers, chemicals, fuel, electricity and labour. As one informant explained, ‘rising fertiliser costs are reducing the appeal of cropping.’ Again, assessments of risk and reward were influenced by rising input costs: ‘The inputs to cropping systems are not being matched by the returns (despite the high prices for grain). Livestock is more physical work but the upfront outlays are less than for crops, which have more uncertain returns.’

Rising input costs, particularly when part of a cost-price squeeze (see immediately below), can lead to substantial, but very different responses by landholders. Some will attempt to reduce input costs by adopting low-input farming systems; others will increase the size of their property or area under a particular enterprise to achieve economies of scale. One informant provided examples where rising input costs had influenced decisions to change their management practices, enterprise mix and the scale of an enterprise.

‘We now run a dryland farm. We used to irrigate 120 acres, and originally milked 70 cows, but we got out of that. Until two years ago we irrigated summer pastures, but stopped that because water became too expensive... Before we worked the land a lot, but now we have only spring fallow. ... much direct drilling, the tractor is used mostly for boom spraying. ... (The reasons for these changes are) ‘mostly cost, ripping paddocks is labour intensive. Fuel costs – this is basic economics. ... The piggery got bigger, and it had to keep getting bigger. This is an issue of scale – inputs keep getting more and more expensive, so we had to keep getting bigger to keep ahead.’

**‘Terms of trade’ and ‘efficiency’**

Farmers often spoke about their ‘terms of trade’ or the ‘cost-price squeeze’ where they were faced with the double impact of declining market prices and increasing input costs. One farmer summed this up:

‘All inputs for farming are becoming more expensive, yet financial returns for farm produce are not increasing equally ... diminishing terms of trade is very difficult to live with. The risks are getting greater – the stakes are higher. We face weather fluctuations and higher input costs; rainfall is less reliable. Prices are starting to improve but are the margins enough to be profitable?’

The typical responses of our informants were to strive for increased scale of operation and more efficient use of inputs. As one informant explained, ‘We face a constant price squeeze. I could buy this farm (neighbouring 800 acres for sale), or intensify on what I have got.’ Another informant said that ‘... maybe we’d increase the size of some of the machinery, such as getting a bigger tractor, or using a different drill ... farming today is different from how our forefathers did it – if you can’t sow 15-20 acres in an hour ...’

Adaptations included expanding the farm through the purchase or lease of land; more intensive use of existing land such as cropping country previously grazed; attempting to control input costs by disposing of equipment and then leasing that equipment or
employing contractors; and adopting new technologies, including new varieties of plants. Again, informants highlighted the importance of the move to lucerne as a critical ingredient in developing more productive and profitable farming systems. This was highlighted by a farmer who said: ‘We have changed lambing time to July from April to match the feed availability. ... changing lambing time has doubled our carrying capacity from 5 DSE\(^2\) to 10 DSE. But doing this also depends on lucerne to carry the lambs into summer.’

A number of farmers said that as part of increasing the scale of their cropping enterprises they were moving away from sowing when the rains fall, to dry sowing (ahead of rain) which allowed them to effectively operate larger equipment on paddocks before they become wet. As one informant said, ‘… we now sow in May regardless of the weather. We sow 24-hours a day, and can sow 400-500 acres/day.’

Farmers wanting to operate on a larger scale can either purchase or lease equipment. One informant explained, ‘We have made lots of investment in machinery this year. In the past, we didn’t have the right machinery, this cost me money. But now I am ready. It is easy sowing when it is dry. Then when it rains, much is already done.’ The advantage of owning equipment and not having to wait for a contractor to turn up to sow was clearly important for this farmer. Another informant leased both land and equipment to free up funds. This person also thought that leasing enabled them to access newer equipment that was more reliable.

(Leasing land is) ‘... not particularly secure, but it has been good, it has allowed me to expand, get a bigger boom spray, economy of scale. Say if I bought those blocks, and increased the size of my holding, I would have to cover the purchase costs, then the costs of upgrading all the equipment. We run an 18 foot boom sprayer, and a 30 foot air seeder. Before, we were running old gear, and were always wondering what would break next. So, we have leased a lot of machinery. Leasing gear – it is a logical way to do it. The taxman gives no points for paying extra tax. The system is geared towards leasing and borrowing. I am comfortable with debt. Some neighbours aren’t, they tend to save up and buy with cash.’

A Muckleford landholder thought that it was more sensible to employ contractors rather than own or lease equipment. This person explained that ‘We are in the process of off-loading machinery because there is too much opportunity cost.’

Another response was to lease or sell all or part of the property. One informant believed that the cost-price squeeze had forced less efficient operators off the land. ‘The “roughies” are gone as family farms have expanded to stay in business. Economics have driven these changes mostly.’ Or as another Kamarooka informant concerned about changes outside their control put it: ‘the farmers that are left are all good farmers. All the bad farmers have gone out the gate. You have to be a good farmer to survive.’

**Need for economic diversification**

Diversification is another approach to risk management. Our informants had diversified their on-property enterprises and as explained above, had also sought off-property income through work and investments. In the Kamarooka zone, where

\[\text{DSE} = \text{dry sheep equivalent, a standard carrying capacity measure for livestock}\]
properties are larger and generally have greater diversity of enterprise options, landholders indicated said they could move into new enterprises quickly to take advantage of emerging opportunities. Off-property work included employment as a contractor on other properties. It seems that in most such situations, income generated off-property is at least partly invested back on-property. However, one informant had decided not to invest surplus funds on-property, and saw off-property investment as part of a long-term strategy to cope with drier times: ‘One of our responses to ten dry years has been to be tight with our spending, but any spare funds go to off-farm investment. Our off-farm assets are worth more than our on-farm assets. We have no farm debt. That makes it easier in these dry years.’ This approach seemed to be more typical of informants in the Muckleford zone, where income from off-farm work and investments often supported unprofitable on-property enterprises: ‘Economically the farm is not viable so my wife has always worked off-farm. We are not in debt but have depended on her income to get by. The place is pretty run down. We’ve put a lot of dollars into fencing. I’ve planted trees. But if I’d had the three kids and this was the only income we would not have survived.’

The increased value of land in both zones has provided longer-term owners with substantial capital gain that offsets low on-farm returns. At least one landholder had used increased on-property equity to invest in off-property income streams. ‘You would never buy land in this area to go farming. The price has gone beyond that. We are looking for ways to utilise the equity in our land, like buying shares. … We have the luxury of our property value. From a purely farming point of view it is no good, you can’t expect to run a viable farm business unless you increase the property size by three times. But it’s great to have terrific equity, to have that option. We could sell off part of the land for lifestyle, and we’d do well.’

Farm forestry and carbon credits were also raised as (potential) means to diversify on-farm activities. These options were also seen as ways to derive economic benefit from less productive parts of the property.

‘Government’ issues

Land use and enterprise management decisions are influenced by governments. For example, governments can negotiate international treaties that open up new markets or place restrictions on imported competitors based on assessments of risks posed by exotic pests and diseases. Informants suggested pig farmers had particularly suffered from recent trade negotiations. ‘At present, we are in competition with overseas producers who are subsidised. Our government doesn’t help farmers… the pig industry didn’t care, they fed us to the wolves. Imports will bring in new diseases. Beef exports are more important, more money and jobs than in pigs, so beef exports are achieved at the expense of pig imports. … Pigs, prices down, can’t make money, so people have gone out of pigs. There is an opportunity in fresh meat. I am planning to get back into pigs for fresh meat.’

Government (and other) regulations can prescribe management practices, such as prohibiting cultivation of native grasses, as discussed in Section 4.2.1. Other regulations that have influenced management practices include those covering the
breeding of chickens for meat (requiring major investment to update sheds), restrictions on new farm dams influencing individual responses to dry conditions, requirements for organic (NASA) certification, including that 20% of the property has to be fenced out for native vegetation, and quality controls on grain for feed. ‘I see fodder production as our opportunity. There are strict parameters on quality of grain, and it is harder and harder to meet them all.’ One informant also indicated that occupational health and safety (OH&S) requirements had driven them to lease equipment to improve safety and reliability for employees, while others suggested that OH&S was a disincentive to employ labour.

A range of grants, incentive programs and rebates are available to landholders to stimulate particular management and practices. Some programs such as those offered by CMAs also offer information, support and advice. Informants described how these types of programs influenced their decisions to revegetate, establish plantations, fence vegetation, control rabbits and weeds, upgrade water infrastructure such as installing pipes and troughs or solar pumps, establish stock containment areas, build new grain silos or expand hay sheds. However, for some, the costs of accepting such assistance, the ‘red tape’, meeting eligibility requirements, or accepting policies on how the money should be spent (e.g. what should be planted, how and where), are greater than the benefits perceived from receiving assistance.

‘I’m happy to respond to policies and programs in relation to climate change. I’ve been considering CarbonSmart plantations offered by Landcare and some of the incentive schemes offered by the CMA. However, most CMA schemes aren’t worth it for the little money/materials offered and the work required.’

The effort, the time and expense of ‘jumping through hoops’ was seen as a disincentive for engaging in a range of activities, from employing people, to engaging with land management programs.

‘There are grants available, such as for solar pumps, but there are too many hoops to jump through to get them.’

‘Yeah, I need to chase more support. However there is too much paperwork to get it. The farm can be viable, but there are too many hurdles.’

‘Legislation and red tape. It’s got to the point where we have to record everything we do, as custodians of the land, we’re held responsible. The bookwork has increased ten fold.’

With challenges facing traditional land uses, some landholders are looking to future opportunities, attempting to forecast changes in government policies and the impacts of these developments, particularly in relation to carbon trading.

‘In the future, there could be 40 metre strips of Eucs for biomass, mixed with cropping, plus carbon offsets, may be enough to live from, making money to fuel Bendigo.’

‘We might look into carbon credits as a way to utilise the farm.’

‘We’d love to (plant more trees), if there was any money in trees. We’d be interested in trees for carbon credits.’
However, one informant displayed cynicism regarding the outcomes of such an opportunity: ‘Payments to landholders for revegetation need to happen. Carbon forests may be an opportunity; however, this may just go the same way where corporate entities dominate the market – leading to social dysfunction.’

**Technology**

A suite of technologies, new products and new knowledge has brought opportunities that have led to on-property changes. As explained already, the introduction of lucerne is an example of an innovation driving other changes in management. Lucerne not only provides better pasture productivity, but also enables adoption of other management approaches, such as cell or rotational grazing, and changing lambing time, as noted by the farmer quoted above (p. 42) who changed lambing time from April to July and thus doubled carrying capacity.

Canola is a new crop in the two zones and has provided high cash returns when market and seasonal conditions are favourable. But canola ‘… is a bit riskier on the grain front. There’s more expense, so more risk. At least we can cut it for hay now which reduces the risk. This year I sold canola hay for silage.’

New cropping technologies, including direct drilling have lowered production costs, increased efficiency of labour and machinery inputs and yielded positive environmental benefits in terms of improved soil health. These changes have contributed to some landholders surviving this drought much better than previous droughts.

‘2002 was worse than 1982, and 2006 was not much better. But in 1982, we got nothing. In 2002 and 2006, at least we got something (crops). With direct drilling, stubble retention, we are smarter at how we farm.’

(In early years) ‘… it was all done conventionally, then I started spraying, then minimum till, and now we’ve gone to zero till with a disc seeder. Now I spray and drill seed. … With the disc seeder, we will do a lot more dry sowing, starting in mid to late April – we can start anyway whether it is wet or dry. This is very different to before – there was no way we could do that. But we’ve got the technology now. You can keep your weeds under control, so there will be cleaner paddocks next year – instead of having to wait for a break.’

A number of informants acknowledged the problem of being too dependent on chemicals, one identifying the opportunity that genetic modification (GM) offers. ‘If we could farm organic, I would… The way we are farming at the moment, I will see the end of chemicals, there will be a massive change in the way we farm within 30 to 40 years. Chemical use is not sustainable. So, we may need a revolution in GM.’ At the same time it is important to acknowledge that sowing genetically modified crops is contentious. ‘We are trying to go more natural because (spouse name deleted) doesn’t like chemicals. We don’t want GM here because it’s too artificial and we are against total market control. The GM is there to make companies rich, we just want to live comfortably – you can’t take it with you.’

Better and larger machinery have also enabled farmers to expand their cropped area and increase efficiency. ‘We used to employ two to three people for six weeks working the paddocks. Now, two people can put in 2,000 acres in five to six days. The machinery is much better.’
The availability of improved information has also assisted farmers to make decisions to deal with the difficult and complex challenges they face.

‘There is much better information on agronomic and pastoral management these days, which has refined our understanding of what this country can do best. The combination of livestock and cropping is challenging, particularly to understand all the synergies and tradeoffs.’

(Our agronomist) ‘... told us to cut hay last year, there was an area of cool water in the Indian Ocean, or something, and he told us this wasn’t good’ (for the success of the crops).

But even the best advice can’t help some people survive, as highlighted by one informant explaining the increased turn-over of land in recent years. ‘It’s such a complicated business to run a farm; there are so many decisions to be made. With the cost of production, some people can’t make returns, so they can get a better return by selling their land.’

**Personal characteristics of landholders**

As explained in the introduction to this section, each person has a specific set of values, attitudes, beliefs, knowledge, skills and experiences. Some farmers are innovators and are more willing to take on new technologies while some are more comfortable with what they know. Some landholders have a strong focus on profitability while others are motivated more by maintaining the productive base of their property. In the section exploring management of remnant vegetation (Section 4.2) we explored the influence of personal attributes – including the values landholders hold and attach to their property – in considerable depth and will not repeat that discussion here. In some cases, value positions could be related to previous family upbringing, stage of life, health and work experience.

Involvement in a family business was often cited as important in exposing individuals to new or contrasting ideas. Partnerships can be fragile, and failed partnerships, a feature of our sample of landholders, had significant impacts in terms of the splitting up of properties into smaller parcels, reducing enterprise diversity and leading to substantially reduced interest and capacity to face the challenges of farming. As one informant observed:

‘Recent personal family problems have dramatically changed the business and made my future uncertain.... I only have a dryland operation now and the property is much smaller, reduced to 200 hectares ... I was going to reassess my farming future at age 55 but I will do that sooner now due to the family partnership breakdown.’

At the same time, some landholders described the changes they had made to property management when parental control was finally relinquished. As might be expected, succession issues are difficult for families. One informant who had worked all their life on their father’s farm, helping to build it up over decades while their siblings went elsewhere to work, faced a difficult problem when their father dies.

‘I’m fourth or fifth generation on the property – in hindsight I wish I had bought my own farm. Working with (father) I’ve had very little money, I was never paid properly. Until 12 months ago, (father) was in control of all the money. ... According to (father’s) will, I’ll have to
find about $1 million to pay out (siblings) when (father) dies. But they have never worked on the farm.’

For some informants, squabbles over succession had led to the collapse of relationships and business partnerships. Some older landholders were faced with the situation where the next generation was not interested in farming (in some cases the younger generation had been actively discouraged from taking on this lifestyle by their parents). In this situation, family heritage – the holding of one property over many generations, the perception of each generation as holding the land for the next – had the potential to be a millstone around the necks of older farmers who didn’t want to sell the property.

‘It’s probably worth a fortune but it’s part of the family. We don’t want to lose it, it’s a family thing. The kids who are 21, 23 and 25 have not been encouraged to take over the farm. They are not interested. One’s at Uni doing accounting another a sheet metal worker and the daughter has done child care, but is working at Myer now. The income from the farm is not enough for the kids; they can earn more money in Melbourne. They can also have a better standard of life. ... We would sell the lot or nothing; we wouldn’t break it up. But we have connections to the property and we don’t want to be the generation to sell up.’

One farmer over 70 years old felt differently about family heritage:

‘We have big problems with generational handover of this farm because one son had a stroke, and the other has a good job with Telstra which makes good money. They would be idiots to get on the farm, but as the second son gets older he gets more interested in managing the property. The best thing to do would be to close-up the land and just leave it. We have done that with 40 acres. Family history might be important to the kids but it’s too hard to make a living off the property.’

Risk management

Individuals have different levels of risk tolerance. A number of our informants described themselves as being ‘risk averse’ while others were clearly willing to take risks that could lead to increased profits. The following quotes highlight some of this variation in attitudes to risk.

‘In good years I would grow more crop but I wouldn’t go into contracts, they are too risky. We never go for huge risk – maybe we should. People did a lot of money around here last year by taking risk and in the last 10-12 years they are behind the 8-ball, with more debt.’

‘There is a shitload of risk (in sowing dry), but I’ll always sow then. You can’t say “I’m not going to sow”. ... Putting in 1,200 acres costs $200,000, to gross hopefully $600,000. That is our business, there are good decisions and bad decisions. ... Last year, we lost money in futures contracts ... it cost us $40,000 when we couldn’t meet our contracts. But, I was able to get five tonnes per hectare for hay in the paddock, and $200 per tonne. I was getting $1000 per hectare, so I only needed to cut 40 hectares of hay to cover that loss. It is tempting
to sign up again (futures contract). If there was 50mm of rain, I’d sign up, because then we’d have 75 mm of sub soil moisture.’

‘I believe you’ve got to spend money to get money. Perhaps this is a more risky approach. But if you don’t do that, you get nowhere. Debt is not a great influence on what we do, we have a budget, and we stick to it. I’ve got one mate who is spending money all the time. I don’t know how he sleeps at night. I’m paying back all the time, my debt is getting smaller. I can sleep at night knowing I can pay it back. But I have mates who don’t go to the bank at all, they are on the same size property as 20 years ago, they are not making money, they are on drought relief, and are happy like that.’

Diversification of income streams, accessing new or expanding existing water supplies, lowering input costs and avoiding debt were some of the key strategies employed to minimise risk that have been explored in some detail in previous sections of the report. Uncertainty around climate change was mentioned by a number of informants as a risk that they needed to manage.

**Labour**

Farming is labour intensive, and the need for labour and its availability can be important factors influencing management. As one informant explained, ‘We have a labour shortage. We can hire labour at only $15 per hour. That is cheap. But there is a big problem getting skilled labour.’ Another informant highlighted the extent that the work demands of farming constrained their capacity to manage remnants for biodiversity conservation values. ‘We want to improve them (trees) for biodiversity, hopefully get the benefit from birdlife and insect activity. Our trees are now old, ageing. We have dying and dead trees. We are trying to keep improving them… But scale is a big problem. For the last seven years, it has been a struggle to keep up with what we are doing.’ As might be expected labour saving innovations were welcomed, including stock containment areas that make it easier to feed stock in dry times, or the use of larger machinery that makes it possible to crop in a shorter time.

Farm forestry involves considerable initial work to establish trees and maintain their form by pruning, with a long lead time before harvesting and an income. As one informant observed, ‘November 1999 was my first planting (farm forestry). I have done a little bit since then, but pruning is the big issue. I have less and less time. I am a perfectionist, so it takes me a long time. My ability to manage more than a few hectares at a time seems impossible. I do it all myself.’

Other tree plantings (erosion control, shelter belts etc.) also require considerable investment of labour (and money in some cases) but provide no direct income at present. ‘I would love to (plant trees) – if there was any money in trees. It all comes down to the cost of labour.’ These opportunities are often passed over because of limited labour or a clash with periods of high work loads. In some cases, the labour demand of a preferred activity means that other activities are avoided or reduced. ‘Lamb production is hard work ... Our biggest problem is managing livestock, it takes so much time. Our background is about 50% of the farm’s operation in livestock. But some sheep will go this year because of the work they take.’

Labour can be viewed as an issue of resource access, but also relates to personal attributes (e.g. stage of life), and the broader operating environment, in particular economic conditions and influences on the availability and cost of labour. Labour
availability/capacity provides a good illustration of the considerable interrelationship between the different sets of factors affecting landholder decision making [Figure 1]. For example, one response to the cost-price squeeze is to increase the scale of farming operations. However, access to skilled labour is problematic in the two case study zones and landholders were concerned about regulations complicating labour hire. One farmer felt the need to expand their operations, but didn’t feel they could manage more land. The result of this was that they didn’t want to plant any more trees because of the extra work and the loss of land from production.

‘We need 3000 acres, but we can’t manage 3000 acres. We can’t do any more than we are doing now ... We would rather have clumps of trees, rather than lines of trees. But scale is a big trouble. We can’t manage any more land, but to take out land area for remnant veg, we would be losing area. The last seven years have been a struggle to do what we are doing.’

Another illustration of these interrelationships is that the demanding physical labour involved in farming can affect decisions about retirement, equipment purchases and the enterprise mix and management practices. For example, as farmers approach retirement they may decide to shift to less intensive enterprises. In this study, examples of ‘stage of life’ decisions included moving out of sheep and goats to focus on wine and grapes and a move to a focus on sheep rather than a mixture of enterprises.

‘I wanted to create a low maintenance property so dad could retire. So we decided to do just one thing and do it well. .... The reason that the farm is now only one enterprise (sheep) is so we don’t need to call on outside labour.’

Physical environment

The location of the property and characteristics of the landscape can also influence enterprise and land management decisions. Proximity to Bendigo was seen as desirable in terms of providing better access to tradespeople and increased opportunities for off-property work and achieving a diversification of income streams. At the same time, increased off-property work limited the amount of time available for on-property work.

As explained earlier, soil type can limit cropping and in turn, income. Shallow, stony soils and low lying, poorly drained soils are both unsuited to cropping which is a major influence on farm income. Hilly country is difficult to cultivate and sow to improved pastures, so there are more remnant native grasses in hilly country. ‘Most of this hill country is native pasture. A lot of it you can’t improve, other than by dropping something from the sky.’ The hill country was also perceived to be better for sheep, as noted by the farmer quoted above (p. 40) who had switched to wool production.

4.3.2: Beliefs regarding climate change

Introduction

We approached this research expecting that landholders would hold different beliefs about climate change and that their beliefs would influence the enterprise and land management decisions. These expectations were supported by existing literature on risk and climate change (Palfreman 2006; O’Connor et al. 2002). In this introduction
we provide an overview of our findings and in the subsequent section we provide evidence from our interviews in each zone to support those findings.

Our informants were asked for their views on climate change, whether they believed that the climate is changing, what they thought were the causes of this change and its effects (see Appendix 1). Our analysis of interview data suggested that more of our interviewees believed in climate change (17) than didn’t (10), with nine others unsure about whether climate change existed and/or were sufficiently unclear about their views to make it difficult for us to discern exactly what they believed.

In general, there was considerable uncertainty about climate change. For example, many informants had trouble discerning the relationship between climate change and drought. Those who don’t believe in climate change tend to see the extended ‘dry’ as part of a natural cycle.

There was also a difference in the level of belief in climate change amongst informants from the two zones. Muckleford interviewees were more likely to be believers in that ten were believers, one didn’t believe and seven were unsure compared to seven believers in Kamarooka, nine non-believers and two who were unsure [Figure 7]. That is, believers outnumbered non-believers in Muckleford but non-believers outnumbered believers in Kamarooka. It seems that our informants in Kamarooka were more likely than informants in Muckleford to have formed or fixed views about climate change in that Muckleford informants were more likely to be unsure/unclear.

**Figure 7: Landholder belief in climate change**

![Figure 7: Landholder belief in climate change](image)

**Kamarooka**

Most interviewees (11) in the Kamarooka zone either did not believe or were unsure about whether the phenomenon of ‘climate change’ existed. The non-believers (9) frequently referred to the existence of ‘natural’ periods of dry conditions that have been experienced – to much greater degrees - in the past, and therefore expected that eventually there would be a return to more ‘normal’ (and wetter) conditions. Some non-believers were suspicious of the motivations of those who believed in and were publicising the effects of climate change. The following quotes epitomise these lines of reasoning:
'It will turn, it will be wet [again] … its just the cycle that comes every 20 years.'

'I am a cynic about climate change. I have no doubt that change is going on but its part of the cycle … I think climate change is hype based around less rain and a two degree rise in temperature … I think it still means we will be viable as farms.'

'Climate change is a theory, not an absolute fact … though it may be believed by a lot of people. We go through a drought period, and suddenly, this is climate change. We are in an extended dry period, we have had them before and we will have them again.'

'We’re in a cycle and we’ll come out if it again … there will be wet and dry years again.'

'Most people in the country don’t believe it. Some definitely do. I can’t really see any concrete evidence looking back in history. I don’t take notice of rainfall predictions. I reckon it’s gonna rain.'

'Climate change is not real … but big business is making a lot of money out of it … it’s just part of the natural climate … we are going back to more normal years … I think a lot of it is just scaremongering.'

Two interviewees were unsure or unclear about whether climate change was real or not. These interviewees appeared somewhat confused – hence it was difficult to clearly discern whether they believed in and/or how well they understood the phenomenon. One interviewee spoke of climate change resulting in changed seasons and changed cropping patterns. However, when the farmer was asked later in the interview if they believed in climate change, their response was ambiguous.

‘There is so much media coverage. You hear about it every second day, so you start to believe in it. … But to really believe in it, I would need to see the figures, the data that proves it.’

The other interviewee was unsure about what climate change was, particularly in relation to what it meant for their farm practices:

‘I honestly don’t know … it’s probably true but I can’t make that mean anything to me on the farm … seasonal variability says that in some years we will still get good crops. I’ve looked at rainfall variability over 100 years and there has been other dry periods of ten years … experts are saying that the rainfalls may change. We might get more in summer. But these are all ‘maybes’…’

Similar to the non-believers, the unsure interviewees referred to historical periods of dry conditions or drought as evidence that what they were experiencing now might not be ‘climate change’. These interviewees wondered whether anyone was or could be totally sure that climate change was occurring.

Of the Kamarooka interviewees who generally believed in climate change (n = 7), one noted that they were ‘totally convinced’, while many of the others were unsure about particular aspects of the phenomenon. One interviewee felt that climate change had to be real, because ‘… so many people are talking about it, (and there are) only a few sceptics.’ Yet, this interviewee also felt that there would always be climate variability (wetter times, drier times), which posed a bigger challenge. Another interviewee
believed in climate change ‘… if it means a deviation from normal trends’ and speculated whether the climate would return to earlier patterns. Another interviewee wondered whether it was too late to do anything about climate change, but was concerned that ‘… we can’t keep going the way we are … climate change might be quicker than we expected.’

The believing interviewees identified certain (weather) effects from climate change – and those primarily related to reduced rainfall. These effects included seasonal variability as mentioned above; more intense weather events; warmer temperatures … less rainfall would be more variable. When describing climate change, several interviewees noted particular implications of those effects, including ‘more risky farming … less reliable forward planning … with water shortages frequent and water more expensive’, as well as rising grain prices – but less yield and reliable supply to meet the demand, and a shorter growing season [and] this limits farming practices (e.g. grazing).

Three interviewees either made direct or indirect reference to the drought and climate change. One interviewee felt that in the future crops would need to be more resistant to drought. Another interviewee who had no doubts about the existence of climate change was unsure if it was linked to the current drought because there had been dry periods before. The third interviewee also noted other dry spells, which they believed were making people complacent about responding more proactively to climate change.

Three interviewees spoke about the causes of climate change. One interviewee felt that climate change was human-induced and would continue because people wouldn’t change their resource use. Another interviewee felt that the climate change was man-made, but felt that the natural variation of the climate was of greater concern. The third interviewee – who also noted human causes – felt that industry, urban sprawl … consumer society were beyond the farmer’s control.

Muckleford

A majority of informants (10) from the Muckleford zone indicated that they believed in climate change. Most of these interviewees were able to describe the effects they felt climate change was having on the weather, including:

- A drying trend (e.g. hotter, drier summers), and therefore either a direct reference to or by inference less and/or more variable rainfall;
- Increased incidence of extreme weather events, such as rainfall coming in downpours;
- A decline in some wildlife (e.g. lizards, frogs); and
- More drought and/or the increasing normality of dry conditions.

Only one of these interviewees readily (easily) defined climate change using concepts/terms closely resembling those emanating from the climate change dialogues of the scientific and policy communities³:

³ For example, according to the Bureau of Meteorology (no date), “Australia and the globe are experiencing rapid climate change. Since the middle of the 20th century, Australian temperatures have, on average, risen by about 1°C with an increase in the frequency of heatwaves and a decrease in the numbers of frosts and cold days. Rainfall patterns have also changed – the northwest has seen an increase in rainfall over the last 50 years while much of eastern Australia and the far southwest have experienced a decline.”
‘… it’s real … although [it is] a small, statistically upward trend … a rising mean temperature … and it is contributing to the dry we are seeing now … climate fluctuations or variability have always been there … the variability is bigger, and more significant than the shift of the system upwards by a few degrees.’

While believing that some kind of change was going on, one interviewee stated that:

‘On a broad level I think something is going on. But I don’t think it is the end of the Earth and I don’t think it is happening as quick as they think. It might be more of a long term cycle. We don’t have the climate history to track what is happening, it’s only been 200 years. But I think the human race has had an impact.’

Other interviewees referred to “human-induced” and “natural” climate change. One interviewee wondering if the recent drought was an indicator of climate change also thought about reports of global pollution resulting from too much economic development. This person said, ‘The world is polluting … the planet’s cycles are being impacted … humans are competing for the biomass … it’s at a cost, things are heating up.’ Another interviewee felt that if most of the change was created by human causes (pollution, too much economic activity) then mitigation was required, but if most of the change was part of the ‘natural’ cycle, they would be able to ride out the dry times:

‘Climate is changing because of the natural cycles since the beginning of time, or you could say that it is because of man’s activity. If it is natural cycles then we have to sit and bear it. We’ve gone through very dry times before. But man’s interference is a very difficult thing. If that is the case, people’s standard of living will have to fall. We will have to cut emissions. We will have to change and be very aware of what we do.’

Similarly, another interviewee speaking about the human causes of climate change felt there was a need to look beyond emissions, and that there were other human activities that had and continued to have significant environmental impacts.

Some of the implications for land management from climate change and climate variability noted by the Muckleford interviewees included:

- higher risk of bushfires;
- increased production costs (e.g. netting of orchards);
- crop damage (e.g. sunburned fruit);
- lower productivity (e.g. reduced carrying capacity in grazing pastures for stock with flow-on effects to markets; decreased ability to grow fruit and vegetables); and
- decreased dependability of water supplies.

Several interviewees spoke about the impacts of climate change beyond their properties, noting how the warming and associated water shortages would have significant impacts on communities. One of these interviewees felt it was critically important to note the ‘bigger picture’ implications of climate change, which they felt would result in ‘… people with a range of lifestyles competing for a finite resource (water), from farmers, to [people in] small towns and big cities … it will entail change for everyone – it has to.’ This interviewee also saw declining levels of
commercial farming activity in the region, and felt that only ‘… the smarter ones in the area …’ (those with off-farm resources, some interests outside farming) would be able to make the necessary changes to maintain their properties as viable farms. Another interviewee was concerned about the impacts of climate change and an apparent lack of action to address these issues.

‘It (piping water to Melbourne) will have an effect on rural areas, reduce the standards of living. Small towns are dying ... (In relation to climate change), there is going to have to be a massive change. Some parts of the country will become more productive and others less. There will be population shifts. We are not preparing ourselves for it ... I think people are trying to kid themselves.’

One informant concerned about the implication of climate change for water supplies felt there was a need to make water more expensive in urban areas. Another who was relatively unconcerned about what climate change would bring for them personally was more concerned about the well-being of the regional community. This interviewee believed that the drying trends were adding to the high levels of stress in the region, and was concerned about the varying degrees of resilience in the community. They predicted considerable demographic and land use change resulting from the withdrawal of a range of rural services, as well as the declining viability of commercial and lifestyle farming.

More Muckleford interviewees (7) than Kamarooka interviewees (2) were unsure or unclear about whether climate change was really occurring or not. Similar to the non-believers in both Muckleford and Kamarooka, and the unsure Kamarooka interviewees, these informants wondered if what was occurring was simply part of a natural cycle, with (often more serious) dry/drought periods now being experienced than before. For example, one informant said that they ‘… were not a confirmed climate change believer ... but [I am] taking notice of the debate.’ This person was not sure how significant ‘climate change’ was compared to natural variations in the weather and rainfall. Another interviewee appeared confused by the different signals and information they were receiving, hearing about the drought of the 1940s, seeing recent forecasts for better-than-average-winter rainfall and hearing ‘… a lot of questions but not a lot of answers’ in relation to climate change. This informant asked the interviewers, ‘Do you know?’ (if climate change is real), while another interviewee who was undecided said to the interviewers, ‘… you tell me.’

Only one interviewee from the Muckleford zone was a non-believer, referring to themselves as ‘… a climate change sceptic.’ This interviewee’s reasoning was similar to the Kamarooka non-believers – they referred to ever present cycles of dry and wet, warmer to cooler, and posed a rhetorical question, ‘… when will global warming turn into global freezing?’

4.3.3: Importance of climate change relative to other challenges

In order to try and determine the importance of climate change relative to other risks, interviewees were asked to discuss some of the current and future challenges they faced. Overall, there did not appear to be significant differences in the challenges listed by interviewees who believed or did not believe in climate change, and only a small number of landholders cited climate change as the most significant issue facing them.
Kamarooka Interviewees

Each Kamarooka interviewee listed more than one challenge, including climate or weather-related issues [Table 4].

Table 4: Summary of current and future challenges for Kamarooka landholders (n=18)

<table>
<thead>
<tr>
<th>Landholders who did not believe in climate change (n = 9)</th>
<th>Landholders who did believe in climate change (n = 7)</th>
<th>Landholders who were unsure and/or unclear (n = 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Maintaining viable property/enterprise size, the ‘dry’;</td>
<td>● Inputs not matched by returns, drought and failed crops, shire amalgamations;</td>
<td>● Water and providing the farm with necessary infrastructure to capture it, lamb production in drought, staying a viable-sized enterprise;</td>
</tr>
<tr>
<td>● Weed management, some seasonal changes, water supply;</td>
<td>● Constant price squeezes, maintaining viable-sized business enterprise, labour costs, how to manage the intensified, variable rainfall;</td>
<td>● Time management, financial pressures of stock management during drought, planning ahead in an unpredictable environment.</td>
</tr>
<tr>
<td>● Animal welfare issues, input costs, rising interest rates, the GM debate;</td>
<td>● Getting big enough, pork imports, feral pests, off-farm income, sowing drought-tolerant pastures;</td>
<td>● Water and providing the farm with necessary infrastructure to capture it, lamb production in drought, staying a viable-sized enterprise;</td>
</tr>
<tr>
<td>● The ‘dry’ and later seasonal breaks, access to water;</td>
<td>● Weeds, increased paperwork, time and money spent on feeding stock;</td>
<td>● Time management, financial pressures of stock management during drought, planning ahead in an unpredictable environment.</td>
</tr>
<tr>
<td>● Accessing water for stock, foxes, land prices, OH&amp;S issues, drought relief policies;</td>
<td>● Dramatic increases in utilities costs, more corporate farms and fewer family farms, work-life balance, weed management practices of inexperienced landholders;</td>
<td>● Water and providing the farm with necessary infrastructure to capture it, lamb production in drought, staying a viable-sized enterprise;</td>
</tr>
<tr>
<td>● Land use change (people moving from rural areas to cities), cheap imports;</td>
<td>● Reduced rainfall from climate change, increasing input costs;</td>
<td>● Time management, financial pressures of stock management during drought, planning ahead in an unpredictable environment.</td>
</tr>
<tr>
<td>● Drought, competition with foreign (subsidised) markets, commodity prices;</td>
<td>● Money to invest in the farm, “recent weather”, time management.</td>
<td>● Water and providing the farm with necessary infrastructure to capture it, lamb production in drought, staying a viable-sized enterprise;</td>
</tr>
<tr>
<td>● Getting the right soil balance, drought, wool prices, family tragedy (illnesses), finding good farm management advice;</td>
<td></td>
<td>● Time management, financial pressures of stock management during drought, planning ahead in an unpredictable environment.</td>
</tr>
<tr>
<td>● Climate (determines the bottom line), wool prices, water prices, government regulations.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Non-climate challenges frequently mentioned included farm financial management matters (e.g. cost-price squeezes, maintaining a viable enterprise size), land management issues (e.g. weed, soil health and pest management), and a range of external issues (e.g. animal welfare campaigns, export markets, government policies).

The ‘dry’ or drought was mentioned by four interviewees, ‘seasonal’ changes or variations were noted as challenges by five interviewees and water access and infrastructure matters were noted by six interviewees. Three interviewees (two believed in climate change, the other did not) felt that ‘the dry’ and increasingly later seasonal breaks or ‘future climate’ had serious implications for reliable water access, and felt these were the most significant challenges they faced.
Muckleford Interviewees
As with the Kamarooka interviewees, Muckleford interviewees identified a range of challenges [Table 5].

Table 5: Summary of current and future challenges for Muckleford landholders (n=18)

<table>
<thead>
<tr>
<th>Interviewees who did not believe in climate change (n = 1)</th>
<th>Interviewees who did believe in climate change (n = 10)</th>
<th>Interviewees who were unsure or unclear about climate change (n = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Maintaining soil health and weed management in dry times</td>
<td>- Biggest is input/output costs (wool prices); climate next – increasing costs, reducing production, personal health</td>
<td>- Lack of rain, stock feed prices;</td>
</tr>
<tr>
<td></td>
<td>- Input costs, pests, water allocation issues/regulations;</td>
<td>- Succession planning in uncertain (productivity, financially) times, drier autumns, land use change (shift to rural residential);</td>
</tr>
<tr>
<td></td>
<td>- GM seed bank, sourcing hay during drought, sufficient power supply;</td>
<td>- Personal health, lack of water and restrictions on new farm</td>
</tr>
<tr>
<td></td>
<td>- Water supply, lack of services in rural areas;</td>
<td>- time management;</td>
</tr>
<tr>
<td></td>
<td>- Marketing and getting best price, the gradual impacts of climate change;</td>
<td>- Time management and prioritising;</td>
</tr>
<tr>
<td></td>
<td>- Lack of good planning &amp; land management by conventional farmers, price input/outputs (for others not the informant);</td>
<td>- Restrictions on new farm dams, the need for off-farm income;</td>
</tr>
<tr>
<td></td>
<td>- Input costs (of purchasing hay), too challenging to run cattle during the dry;</td>
<td>- Rising input costs not being matched by return prices,</td>
</tr>
<tr>
<td></td>
<td>- Lack of water, pest animal impacts on revegetation;</td>
<td>- weather fluctuations/less reliable rainfall at same time as</td>
</tr>
<tr>
<td></td>
<td>- Appropriate pasture management in face of climate change (drier times);</td>
<td>- higher input costs;</td>
</tr>
<tr>
<td></td>
<td>- Lack of water to revegetation, future dry (climate change) and potential impact on food production.</td>
<td>- Need to continually increase productivity – but wool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>production not profitable.</td>
</tr>
</tbody>
</table>

Six interviewees felt that maintaining profitable enterprises in the face of rising input costs and/or poor commodity prices was the biggest obstacle they faced. Climate change or ‘the dry’ and water issues (reduced access to water) were the next most commonly listed set of issues. One interviewee spoke about climate change and the need to manage their property proactively as the most significant challenge they faced.

4.3.4: Perceived ability to adapt
Kamarooka
Most of the Kamarooka interviewees who did not believe in or who were unsure about climate change appeared to be relatively confident about their ability to adapt in
the future to drier times, should they continue (e.g. more drought, current drought lasting). Some informants spoke about the advantage of having access to water or operating with low debt levels. Most informants expressed the view that there was not much you could do other than to continue on as they had, and they would do what was necessary – even if what that was, was not immediately apparent. The quotes below capture some of these sentiments:

‘... as long as you don’t have too much debt, and we’ve always looked after the land. .... This drought is not as bad as previous ... can’t do anything about it ... we’re optimistic and keep trying ... gambling with crops ... but we’ve always had backstops.’

‘I think we can cope with less rainfall ... the temperature doesn’t count in my view – its just moves us north ... there is not much you can do about the climate – adapting in my lifetime and changes won’t be that big a deal.’

‘We are pretty right for water. Perhaps if it never rains again that would be a problem. But it will rain, it always does.’

‘We haven’t done too badly through drought ... we’re in a cycle and we’ll come out of it again ... [it’s been] harder to make a living in regular years so probably will be harder.’

‘If things continue as they are now (drought) we could rely on dryland lucerne and irrigation, maybe GM innovations ... I’m optimistic that we’ll learn to cope ... we’re an exceptional race of people us farmers ... we’re in for some challenging times ... we’ve adapted well.’

‘It (drought) hasn’t changed what we do, it might have changed the output of what we do ... the dry is something you have to respond to in a day-to-day management but it doesn’t change the plan for what you do next year ... we just need to continue to respond to whatever comes.’

For a number of the Kamarooka informants, climate change is just another challenge to their future that is outside their control. Two of the seven Kamarooka interviewees who believed in climate change were doubtful about the future. Both individuals were planning to reassess their options in a few years time. One felt that the property viability would depend on outside support (government), and clearly doubted their ability to adapt if the current dry conditions (caused by climate change) continued. ‘Honestly, if it stays like this, I don’t know if I can stick it out.’ The other was considering selling out ‘to pursue other personal interests.’ Other informants felt that adaptations already adopted in response to years of drought had prepared them for climate change and that adopting strategies such as remaining flexible and controlling debt would be critical to survival; ‘we don’t want to put too-tight a noose around our neck.’ One informant believed that climate change would result in greater risk and a less reliable environment for forward planning, but could see opportunities as a grain grower, with rising global populations and demand for grain for ethanol production despite a less reliable yield. One informant believed they were different from most people, who are ‘hoping for a return to better climate conditions.’ Being totally convinced that climate change is occurring and that it is the biggest factor driving their planning decisions, they saw need for great change, and were confident because ‘off-farm income will give us the ability to adapt, but not everyone can do this.’
Muckleford

Four of the ten Muckleford interviewees who believed in climate change operated non-commercial properties. On the surface, these four interviewees did not appear especially worried about the potential impacts of climate change (primarily increased dry and reduced water supplies) on their properties. Their properties had been ‘purpose built’ and/or they were preparing for the likelihood of lower and more variable rainfall (e.g. water tanks). However, two of these interviewees were very concerned about the potential effects of climate change on the well-being of others in the community (primarily commercial farmers operating in increasingly marginal situations). The other non-farmers spoke about being prepared to leave their properties if they could not maintain an adequate water supply; however, the idea of leaving filled them with considerable sadness.

Of the six commercial operators who believed in climate change, three appeared to be confident they could cope with climatic change. One informant referred to the flexibility they were afforded due to high land values and their proactive planning for climate change. At the same time, two farmers seemed burdened by the general conditions of farming and were generally pessimistic about the future. One of these interviewees was looking to wind down their operations and sell the property for superannuation. The other interviewee referred to running the farm as ‘… a rope around your neck getting bigger’, and was considering leasing out their property.

The Muckleford interviewee who did not believe in climate change seemed to be confident about their ability to adapt, as they did not perceive any significant impacts on their property of an extended dry period. This property was not run commercially, and they had no plans to plant anything that would not survive dry times.

Three of the seven Muckleford interviewees who were unsure or unclear about their beliefs about climate change appeared highly stressed about the current climatic conditions affecting farming. Two of them ran commercial operations, one had a non-commercial property. One of the commercial operators worried not only about their own survival, but also worried about others struggling with the emotional impacts of drought, referring to ‘… a lot of people with suppressed energy [and] burdens.’ The other commercial operator was deeply concerned about their debt levels, the costs of ‘… feeding stock (due to drought) when they should be feeding themselves’, their children’s future in farming, and wondered about the wisdom of toughing it out.

Two other commercial operators unsure about the reality of climate change were somewhat more circumspect about their future. One interviewee who was over 70 felt their time operating the farm was limited irrespective of climatic conditions, and they relied on off-farm investments. The other interviewee seemed fairly confident about their future – even if it was not clear what that future held:

We are moving forwards but I don’t know how long we will go … I like doing jobs properly … I like adaptability as a tool … I am a knowledge seeker and I like to run the farm as well as I can – every acre has to work for me … the spring rains have only failed at the end, so I am optimistic. I will keep going until I run out of money, but I will not run the farm down – I do have contingency plans and the kids say they want to live here and I have a close relationship with the farm.
Section 5: Conclusion

This research explored rural landholder responses to climatic variability in the North Central CMA region. Interviews in the Muckleford and Kamarooka zones near Bendigo, central Victoria, gathered information about rural landholders’ experiences with drought, beliefs about climate change and ways they have changed their land use and enterprises in recent years, with a particular focus on remnant vegetation management. In turn, these data enabled us to explore the relative importance of climate variability as an influence on landholder decision making. There has been very limited Australian research exploring these topics, and the methodology and findings of this study should be of interest to a wide audience.

Given the potential for confusion over the interpretation of the terms ‘climate variability’ and ‘climate change’, the following definitions of the terms have been adopted for the purposes of this report:

‘Climate variability’ refers to the experience of landholders of past and current variations or trends in climate, including ‘drought’.

‘Climate change’ refers to change that is attributed to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

The range of responses to climate variability by rural landholders

Some broad patterns in landholder adaptations are evident. In some instances these are similar across the Muckleford and Kamarooka zones. The landholders interviewed were found to be making a conscious effort to cope with reduced rainfall and water availability. These responses include identifying new water supplies such as groundwater bores, capturing more surface water (by cleaning out and expanding dams, and installing tanks), and improving water use efficiency (by installing pipes and troughs, and in some cases adopting minimum till practices to conserve soil moisture). Informants in both zones, but particularly in the Kamarooka zone said they had increased the area under lucerne (a deep-rooted perennial pasture species) in the last decade and that this had been important in maintaining enterprise viability through the dry times.

Changes to climate and the wider economy have contributed to substantial enterprise adaptations amongst informants in this study. While similar responses were reported in both zones, a pattern emerged where Muckleford zone landholders moved to low input and low management farming systems to reduce their financial risks, improve ecological sustainability and achieve their lifestyle preferences. By comparison, in the Kamarooka zone, landholders were more likely to be ‘farmers’ who sought to improve productivity by expanding, intensifying or refining their operations in other ways.

The Muckleford and Kamarooka zones have different agronomic, biophysical and socio-economic characteristics. The Muckleford zone is characterised by a diversity of farming and smaller ‘lifestyle’ properties, whereas Kamarooka is characterised by larger commercial cropping and livestock properties. These differences appear to underpin differences in the pattern of responses to climate variability in the two zones.
Kamarooka landholders were also generally more optimistic about their ability to respond to market and climatic conditions, in part because of the benefits of improved technology (e.g. introduction of lucerne).

**Managing native vegetation in a drier environment**

As might be expected, a range of factors influenced landholder management of native vegetation in Muckleford and Kamarooka. This mix of factors includes values attached to native vegetation, prevailing economic conditions, drought, experience with recent revegetation efforts, the availability of labour and landholder capacity to maintain areas, relationships with agencies and organisations, regulations and expectations about future returns from providing environmental services.

Values that landholders attach to their properties are an important predictor of behaviour. Most interviewees in this study attached a high value to the native vegetation on their property. Landholders interviewed tended to fall into one of two broad groups: those who valued native vegetation for its production values and those who valued native vegetation for its conservation values. Farming as an occupation and dependency on income from agriculture are more common in Kamarooka than Muckleford. It is not surprising then that the conservation values of native vegetation were more highly rated by landholders in the Muckleford area and production values rated more highly in the Kamarooka area. Landholder values appeared to influence their land management. Some interviewees with strong conservation values said they intended to ‘revegetate’ degraded land. For some in the Muckleford zone, revegetation or ‘regeneration’ was their primary land management objective. In both zones, landholders identified remnant vegetation they wished to protect. Often these remnants were along creeks and efforts had been made to exclude stock and regenerate such areas. Paddock trees were identified as being under threat in both areas and the widespread concern about the declining health of paddock trees was reflected in a desire for information and assistance with the management of paddock trees. Nevertheless, few landholders appeared to have made substantial efforts to protect or replace such isolated trees.

There is now a body of Australian research demonstrating that most landholders attach a mix of social, economic and environmental values to native vegetation on their property (e.g. Dettmann et al. 2000; Curtis and Robertson 2003a). As the example above illustrates, these values are not always in conflict. In the Muckleford area native grasslands are now mostly confined to the less accessible and low fertility hillsides. Most landholders, including those with a commercial agriculture focus, attach high conservation values to these grasslands and have or are considering destocking. Efforts to encourage conservation of native vegetation become more problematic when production and conservation values are in conflict. As explained above, native grasslands are increasingly under threat in the Kamarooka area because landholders seeking to maximise production now have the capacity to convert low-lying areas with heavy soils into lucerne pastures.

There was also evidence that these value conflicts shaped landholder responses to remnant vegetation programs. There was some evidence of landholders ploughing native grasslands ahead of the introduction of the ‘ten year’ regulations to ensure they didn’t lose the potential to use areas for production. Some landholders said they would not enter into agreements to implement programs if the activities proposed would restrict their capacity to generate an income. Others said that ‘red tape’ affected
their uptake of programs. Muckleford interviewees were more likely to say that the advice and support offered by organisations, including the NCCMA and Landcare was important in helping them implement work to conserve native vegetation. On the other hand, Kamarooka interviewees were more likely to say that access to labour and financial support for the purchase of materials were important incentives for them to take on revegetation work.

The ongoing dry conditions have resulted in decreased planting of native trees and shrubs in both zones and there was some evidence of increased grazing of areas previously fenced to manage stock access to native vegetation. Some interviewees reported low survival rates for tree seedlings from planting and direct seeding. There was also evidence that the drought had reduced landholder engagement in Landcare and group activities. At the same time, many interviewees said they intended to establish native vegetation in the future.

**Importance of climate variability as a factor contributing to enterprise/land management decisions**

As might be expected, a large number of factors were identified as affecting decisions about enterprise and land management. These factors have been related to a decision making model (Mazur et al. 2008) outlined in Section 2.3, which identifies four interacting themes: characteristics of individual landholders, access to resources, characteristics of the adaptation, and factors associated with the external operating environment. In the report we have provided an influence diagram to emphasise the interactions between different factors (Section 4.3.1). The factors reported by informants as affecting land use and enterprise decisions are summarised below, some of which can fall under more than one theme.

**External operating environment**

- Climate, particularly lack of rainfall (environmental conditions);
- Water supply, including irrigation water supplies and markets (government policy, economic conditions);
- Economic issues, including market prices for commodities and inputs such as feed, fertiliser and diesel; trends in these costs over time relative to prices received or farmers’ terms of trade; improvements in efficiency; and opportunities for diversification (economic conditions);
- Social issues related to rural population decline, the ‘tree-change’ phenomenon, rising land values, increased environmental awareness, changes in consumer behaviour as a result of animal welfare campaigns, and declining levels of farmer autonomy (social conditions, also Access to resources);
- The role of government, including international trade agreements, incentives offered for natural resource management, current and future regulations including potential rules related to greenhouse abatement (government policy/programs);
- New technologies including the introduction of new pasture varieties, direct drilling, chemicals, larger machinery and GM technology (also Access to resources); and
- Physical environment including proximity to urban centres and access to markets, nature of the terrain and soil type (operating environment).
Landholder characteristics

- Personal attributes of landholders including their long-term goals/aspirations, personality type, values, and experience and training;
- Personal situation of landholders including their family relationships, stage of life, health, role in property management of property, extent and type of succession planning and extent of family heritage/connection; and
- Approach to risk management including the landholder’s level of risk aversion, familiarity with risk, extent of on and off-property diversification, level of debt, level of control over input costs, climatic uncertainty and crop sowing times (also Access to resources).

Access to resources

- Labour issues including the capacity of the individual and family to provide labour inputs, the cost of labour and ability to source labour (also Landholder characteristics).

Previous research has established links between belief in climate change and understanding of its causes and likely consequences, and support for adaptive action (see discussion in Mazur et al. 2008). Our analysis of responses to questions about climate change suggested that interviewees could be assigned to one of three groups: ‘believers’, ‘non-believers’ and those who are ‘unsure’ about climate change. About half of those interviewed expressed views that suggest they believe climate change is a reality, with slightly more ‘believers’ in Muckleford than Kamarooka. The main difference between the two zones was that in Muckleford almost all of those not expressing belief in climate change were ‘unsure’, whereas in Kamarooka they were clearly ‘non-believers’. These findings will need to be considered by those attempting to work with landholders to address climate change issues in these areas.

Despite a high proportion of ‘non-believers’ amongst Kamarooka informants, the Kamarooka landholders have demonstrated a high level of capacity to respond to ongoing drought, to a large extent because they had the ability to include lucerne in their farming systems. This finding is consistent with research establishing that landholders who are farmers by occupation are more likely to adopt practices with a production focus than non-farmers (Curtis and Robertson 2003b; Curtis et al. 2006; Curtis et al. 2008). These findings suggest that occupation is an important factor mediating responses to climate change.

Land management decisions are complex and rarely made in response to a single factor. At some point in the interview process, every informant touched on the influence of climate variability on their land management. Nevertheless, only a minority of interviewees identified climate variability or ‘climate change’ as the most significant issue they faced in their decision making. However, climate was frequently mentioned, as was the general topic of economic issues. Overall, there were few differences in the challenges identified by ‘believers’ and ‘non-believers’ in climate change or informants in the Kamarooka and Muckleford areas.

Economic influences on decision making included the cost-price squeeze, particularly rising interest and labour costs and competition from cheap imports, and the resultant imperative to increase production and productivity; the rising cost of land as a factor constraining expansion options; and the growing importance of off-farm income and the constraints imposed upon on-property work. Climate related influences on decision making included the ‘dry’ or drought, uncertainty about future climate...
(including climate change) and changes to the distribution of rainfall across the seasons, including the onset of the ‘autumn break’. In turn, water supply issues were expressed in terms of the need to consider uncertainty about the allocation of water for irrigations, the rising cost of water, increased workloads and costs involved in securing and maintaining water supply, the costs of compliance with government policies restricting the construction of new farm dams and the challenge of identifying drought tolerant pasture and crop species.

A key difference between ‘believers’ and ‘non-believers’ was that the latter were typically more confident in their ability to adapt to drier climate. ‘Believers’ and those who were ‘unsure’ about climate change were typically less confident of their ability to adapt successfully. In the Muckleford area this lack of confidence in adaptive capacity was associated with high levels of personal stress. Some of these interviewees were concerned about their current personal situation or their future viability while others were more concerned about the viability of commercial agriculture in their area and community-wide impacts of climate change. Some interviewees appeared to have concluded that in a future with declining rainfall, their lifestyle would be compromised and they might be forced to move elsewhere.

There were some important differences in the responses of landholders interviewed in Kamarooka and Muckleford to drought and climate change. Kamarooka interviewees had taken a more active approach to enterprise and land management decision making and were more likely to believe they had the capacity to respond to the ongoing drought than landholders in the Muckleford area. Adoption of lucerne by many Kamarooka landholders is a good example of the contrast between the two areas. Lucerne is a high quality pasture that is also drought tolerant and has the capacity to utilise summer rainfall. Kamarooka interviewees explained that lucerne, in combination with the efficiency gains from adopting minimum tillage technologies and larger equipment had helped them cope with the current drought better than previous droughts. Indeed, some in Kamarooka felt the dry conditions and lucerne had enabled them to bring low lying and boggy areas with heavy soils that were unsuitable for cropping into production. This trend represents a powerful example of the capacity of landholders to adapt to drought and climate change, highlighting the important role that the physical environment and access to natural resources may play in adaptive capacity. However, if production orientated adaptation responses are not consistent with native vegetation management, the trade-off may be a loss of important habitat with landholders converting areas of native grass and wetlands into production.
References


DSE – see Department of Sustainability and Environment

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NCCMA see North Central Catchment Management Authority


Appendix 1: Interview schedule

Ecosystem risk
Understanding landholder adaptation to drought and climate change

Interview schedule

The topic for discussion in the in-depth interviews is divided into three broad areas:

- background to the interviewee (e.g. their property and their values);
- past changes experienced and how these may have influenced property management; and
- perceptions of future changes and challenges and how they might respond.

In all these areas that explore change, we are interested in how they perceive climate variability and climate change, how these have influenced property management decisions and how important they are in relation to other changes and challenges. The interview will be concluded with a brief structured survey to gather basic demographic and socio-economic information. There will be various attitudes, values and land management practices, not all properties are used for commercial purposes.

Question 1: What is your personal and farming (land management) background, and how do you manage your property? [may take 20-40 minutes]

This topic area seeks to get the interview going by giving the informant some freedom to identify what is important to them, their background, history of property and land use (including remnant veg), and ultimately provide something on their values.

- Can you tell me something about yourself, your journey, how you have come to be where you are today?
- Can you describe your property to me? (We are seeking a physical description, perhaps some emotional connection, as well as indications of different land uses and how important they are.)
- What are your current activities on your property (commercial & non-commercial)?
- What do you like about living here? What are the disadvantages of living here?
- Do you have any remnant vegetation on your property? How much? What proportion of property/area?
- How has that come to be retained as remnant veg?
- Is it important to you that you keep this remnant veg? Do you plan to increase/decrease the area of remnant veg? Why?
- What are your plans for the future, both short-term (i.e. within the next 3 years) and long-term (i.e. 10 years & beyond)? (Personal? For the property?)
Question 2: What have been the major changes you’ve undertaken on your property in the past decade (e.g. physical, management approach, enterprise mix, expectations, lifestyle), and why? [may take 20-30 minutes]

This topic area seeks to understand the factors that have influenced or changed their property management (past experience). For commercial farmers this will include enterprise activities and strategies, but could also include various non-commercial, lifestyle activities etc. Climate variability/drought may be raised as a factor here, but this topic seeks to understand the different factors, and how important they have been in influencing property management decisions. This topic will require an exploration of both the short term responses to immediate challenges, threats, opportunities, as well as the longer term changes made – vegetation management is likely to be a strategic issue requiring longer term thinking (area under remnant veg, removal of veg for different land use, veg planting). But many enterprise changes may be relatively opportunistic or short term, responding to particular climatic events or market conditions.

- Have you made any significant changes in your enterprise or the way you manage your property in the last 10 years? Why have you made these changes? (What factors might have contributed to you making this decision?)
- How has your operating environment changed over the last 10 years or so? (Environmental, salinity etc., economic, global, technological, political, personal…?)
- How have different changes in your operating environment influenced your enterprise/property management decisions? (Explore different changes, short term responses e.g. planting early, selling stock, compared with longer term changes in enterprise nature etc.)
- What strategies have you adopted that you would describe as short term – responding to particular challenges or opportunities as they arise? (For each of these, what factors contributed to such a strategy being adopted?)
- What strategies have you adopted that you would describe as long term?
- What are the greatest challenges or threats that you have faced in managing your property and achieving what you want from it? How have you responded to these challenges? (Do you seek to manage the risk posed by such challenges?)
- How do you currently cope with year to year changes in seasonal conditions?
- How important has climate variability been in influencing your short term decisions? … your long term decisions? (Are wet periods short term opportunities vs. drought long term threat?)
Question 3A: What are the major challenges you expect to face in the future, and how important is climate change (climate variability?) to your farming future? [may take 20-30 minutes]

This topic builds on discussion of past experience to look into the future to consider what they perceive to be important future threats and influences to their land management / enterprise, and how they think they might respond to these. This topic asks specific questions on their understanding of climate change, and the threat that it poses to their land management and enterprise, as well as how they might respond to future climate change. It would be useful to know what they think may be the most important or effective responses they could make in future in response to climate change.

- We have been talking about your past experiences and how these have changed your land management / enterprise management decisions. Now I would like you to look into the future. What do you think might be the most important factors that influence your future property management decisions? (… that influence your ability to run a viable operation?) Do you consider these could be a threat to your operation’s viability? …the way you manage your property? How? Do you see new opportunities arising for your operation/property management in future?

- Do you believe that the climate is changing? What do you think the cause of climate change might be?

- What are the effects of climate change? Have you observed any effects of climate change in this region? We have been experiencing an extended drought in recent years. Do you think this drought is related to climate change?

- What might be the implications of climate change to you and your property?

- How likely do you think these things are?

- How harmful might these consequences of climate change be to you and your property?

- Have you made any changes in your property management in the expectation of a changing climate? (future changes of climate) What changes?

- What other changes could you make? What strategies are available to you to respond to future climate change? At what point would you make such changes? How effective do you think these changes might be in responding to climate change?

- What obstacles or challenges do you face in responding to climate change?

- How important do you think climate change will be in the big picture, in shaping the world outside your own life and property?
Question 3B: If informant gives negative response to issue of climate change -

If informant does not believe in ‘climate change’, we still need to explore their perceptions of future management approaches available to them and the role of climate variability. Such people will have experienced drought in some form, and so should be capable of considering future trends and implications. Even if they don’t believe in climate change, or don’t accept that it is human induced, how would they respond to a longer term climate cycle that results in hotter and drier weather?

Possible structure:

- We have been talking about your past experiences and how these have changed your land management / enterprise management decisions. Now I would like you to look into the future. What do you think might be the most important factors that influence your future property management decisions? (… that influence your ability to run a viable operation?)
  Do you consider these could be a threat to your operation’s viability? …the way you manage your property? How?
  Do you see new opportunities arising for your operation/property management in future?

- Do you believe that the climate is changing? What do you think the cause of climate change might be?

- We have been experiencing an extended drought in recent years. Do you think this drought is part of a longer term climate cycle?

- If drought became more common or more intense in the future, what might be the implications to you and your property?

- How harmful might more common and intense droughts be to you and your property?

- How would you cope with an increase in average temperature?
  What changes would you need to make in your property management?

- How would you cope with a decrease in average rainfall?
  What changes would you need to make in response to a decrease in rainfall?

- Have you made changes in your property management to reduce the impact of any such future periods of climatic stress

- What other changes could you make?
  (What strategies are available to you to respond to future hot dry periods?)
  At what point would you make such changes?
  How effective do you think these changes might be in ensuring the ongoing viability of your enterprise?

- What obstacles or challenges do you face in implementing such strategies?
Question 4: Remnant vegetation

I would like to return to our discussion of remnant veg. (Further exploration as conclusion to interview – depending on what came out of initial questions on remnant veg. Importantly here, some landholders may be retaining areas of native grassland – protecting from ploughing, cropping etc. Important to get a handle on this as well as remnant trees.)

- Confirm remnant veg area
- Nature of remnant veg (e.g. box woodland, native grasses etc. and area of each)
- How would you rate the health of the remnant veg? Perception on long term viability? What may be indicators of the state of health? (e.g. self regenerating)
- What is your management approach to this part of your property? (e.g. permanently fenced from grazing, seasonally grazed?)
- What plans do you have for future management of remnant veg?
- Have you undertaken any revegetation works? Why?
  How much time & other resources do you invest in managing the remnant vegetation each year?
  Is it getting easier or harder (more expensive) to manage the remnant vegetation than previously? Why?

Would you like to make any other comment in relation to the topic of the interview?
Appendix 2: Questionnaire

Structured survey [may take 5-10 minutes]

After interview – ask them to answer a few more questions – a quick structured survey to confirm specific details. (Such details may already have been offered in some cases). Interviewer should ask these questions, and provide answers below, any explanation can be added.

Male          Female (circle)

How old are you? ______________

How would you describe your main occupation? ______________
(e.g. farmer, teacher, retiree)

Are you the owner of the property?
Owner-operator          owner          operator/lessee (circle)

For how many years have you been managing the property? __________

For how long has the property been in your family? __________

For how long do you expect you will be responsible for managing the property? __________

Do you have any succession plans to keep the property in your family?
YES      NO

Do you have any plans to sell part or all of your land?
YES      NO

Are you a member of a local Landcare group?
YES      NO

If yes, how many group activities did you attend in 2007? __________ activities

Are you a member of a commodity or production group?
(e.g. Cropcare, Flockcare, Best Wool etc.)
YES      NO

Please give details. ____________________________________________

In the past five years, have you received government funds, including through the North Central CMA and Greening Australia, for work on your property to address land and water management issues
(e.g. NHT, NAP, Landcare etc.)
YES      NO
Size of your property? __________ Ha

Major land use by area? ____________________________ __________ Ha
__________________________ __________ Ha

Remnant veg. by area ____________________________ __________ Ha
(e.g. box woodland, unimproved native grasses)
[if not previously offered]
__________________________ __________ Ha

Historic average annual rainfall __________ mm

Total rainfall last year __________ mm

Is this property your primary place of residence? YES NO

If YES, Number of people living on property? _________________

Who?

If NO, Number nights per week you spend on property? _________________

Where is your primary residence? _________________

Full time workers on property? (FTE) _________________

Employees? (number) _________________

If property runs an income generating enterprise:
During the last financial year, what was your enterprise profit? (circle)

Negative profit  break even  < $50,000  $50,000 to $100,000  > $100,000

What percentage of your family income comes from off property? __________

What is the nature of this outside work ____________________________
(and who undertakes this work?) ____________________________

Thankyou very much for your time.
Appendix 3: Information sheet and consent form

Understanding landholder adaptation to drought and climate change

Institute for Land, Water and Society, Charles Sturt University

THE RESEARCH:

Landholders and farmers across Australia face many challenges, including a variable climate. Much of south-eastern Australia has experienced a difficult drought over the last decade, with dramatic economic, social and environmental consequences that have threatened individual farming enterprises, caused stress within rural communities and challenged our ability to manage natural resources.

Given the ongoing challenge that a changing climate may pose, it is important that policies and strategies for supporting landholders in their farming enterprises and management of natural resources are founded on a good understanding of existing and potential landholder responses and practices, and of the factors that may influence such responses.

This research seeks to understand landholder experiences of and responses to climatic variability, and perspectives on future challenges and opportunities. The research will seek information on adaptations in farming practices, but also in relation to other natural resource management practices, such as water and remnant vegetation.

We are seeking your input to assist us in this research. Your input will be valuable in generating a better understanding of how landholders respond to climate variability and in developing strategies to assist landholders in the face of ongoing climate change.

The research is being undertaken by the Institute for Land, Water and Society at Charles Sturt University, in collaboration with the North Central Catchment Management Authority, and will contribute to the development of strategies to support the region’s landholders.

The research will give you the opportunity to discuss your experiences of past management of your property, particularly in relation to climate variability, as well as your expectations of future challenges and how these might be met. The research will draw together these experiences and perspectives from landholders from across your region, and from the northern (Kamarooka) and southern (Muckleford) zones of the North Central CMA region, as well as drawing on what we know from similar studies in different parts of Australia. While your involvement in the research will contribute greatly to our overall picture of how landholders perceive and respond to change and challenges, the outcomes of the research should also provide you with a better understanding of how other landholders are responding to the same challenges that you are facing.

THE PROCESS:

The research will be undertaken by in-depth interviews with landholders. Individual interviews will be conducted by one or two members of the research team and will take between one and two hours of your time. Written notes of your responses will be made during the interview, and your responses will be compiled into a research report, but may also be published in academic journals or other formats.
YOUR RIGHTS:

You do not have to participate in this research. You have the right to withdraw from the research at any time. Non-participation or withdrawal will not result in any penalty or discriminatory treatment. While your responses are important to the research and specific comments may be used as quotes to illustrate particular points in publications, your identity as the source of any particular information will not be revealed in any form of publication of this research. It is proposed that informants be identified and acknowledged for their contributions in an Appendix to a research report.

As this research will be asking you about your experiences of drought, there is potential for this to raise issues of stress or anxiety for you. Some support services in your region include:

- Rural and Financial Counselling Service: 03 5442 2424
- General and Personal Counselling, McIvor Health and Community Services: 03 5430 0500

RESEARCH TEAM:

The research team from the Institute for Land, Water and Society, Charles Sturt University includes:

- Dr Rik Thwaites
- Dr Digby Race
- Dr Nicky Mazur
- Mr Royce Sample
- Mr Chris Harrington
- Ms Eloise Seymour

Further information on this research can be obtained by contacting either of the project leaders:

Dr Rik Thwaites (02) 6051 9993 rthwaites@csu.edu.au
Professor Allan Curtis (02) 6051 9730 acurtis@csu.edu.au

NOTE: Charles Sturt University’s Ethics in Human Research Committee has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Committee through the Executive Officer.

The Executive Officer
Ethics in Human Research Committee
Academic Secretariat
Charles Sturt University
Private Mail Bag 29
Bathurst NSW 2795

Tel: (02) 6338 4628
Fax: (02) 6338 4194

Any issues you raise will be treated in confidence and investigated fully and you will be informed of the outcome.
CONSENT FORM
To be signed by informant prior to interview

Name of Research Project
Understanding landholder adaptation to drought and climate change.

Researcher Contact details
Dr Rik Thwaites
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Charles Sturt University
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Ph: (02) 6051 9993
Email: rthwaites@csu.edu.au

Professor Allan Curtis
Institute for land, Water & Society
Charles Sturt University
PO Box 789, Albury NSW 2640
(02) 6051 9730
acurtis@csu.edu.au

The purpose of the research has been explained to me and I have been given the opportunity to ask questions about the research and received satisfactory answers.

I understand that I am free to withdraw my participation in the research at any time.

I am aware that information I provide will be recorded by handwritten notes, and I understand that any information or personal details gathered in the course of this research about me are confidential and that neither my name nor any other identifying information will be used without my written permission.

Charles Sturt University’s Ethics in Human Research Committee has approved this study.

I understand that if I have any complaints or concerns about this research I can contact:

The Executive Officer
Ethics in Human Research Committee
Academic Secretariat
Charles Sturt University
Private Mail 29
Bathurst NSW 2795

Phone: (02) 6338 4628
Fax: (02) 6338 4194

Signed by:

____________________________________________________
Date _____________________________