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Rural Western Australians Attitudes to Climate Change, Climate Change Science and Governance

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This thesis is presented for the Degree of Master of Philosophy (Agriculture)

of

Curtin University

December 2012

Declaration

I declare that this report contains no material that has been accepted for the award of any other degree or diploma at any university.

To the best of my knowledge and belief this report contains no material previously published by any other person except where due acknowledgment has been made.

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Abstract

This research examined southwest WA farming communities' attitudes to climate change and the influences on their attitudes. The research asked if rural people thought climate change was occurring, if it was natural and if it was a threat to their businesses and communities. The research also examined rural peoples' perceptions of science and government as an influence on their views on climate change.

Survey results (N 411) indicated that: 36% of participants believed climate change was occurring; 24% thought it was human-induced; 43% viewed climate change as a threat to their communities; and 33% of farm/agribusiness participants viewed it as a future threat to their businesses. Generally, there was a lot of uncertainty concerning whether climate change was occurring, natural and/or a threat.

The research identified three typologies of 'Acceptors', 'Uncertains' and 'Sceptics' defined by their climate change and science values, and length of time farming and living in an area. 'Acceptors', with the least experience, believed climate change was a human-induced threat and valued knowledge provided through science. 'Uncertains', who had more farming experience than 'Acceptors' but less than 'Sceptics', were unsure if climate change was a human-induced threat, and were unsure about the value of scientific knowledge. 'Sceptics' had the most farming experience, believed climate change was natural, was not a threat and did not value scientific knowledge about climate change.

Although results indicate challenges for climate change extension, they also suggest potential opportunities for addressing communication issues. The utilisation of existing forms of social and rural media networks already a part of the scientific knowledge translation process could be better used in promoting climate change adaptation and resilience in the Western Australian agricultural sector.

Acknowledgements

I cannot overemphasise my appreciation to my two Masters' supervisors, Dr Christine Storer and Dr Angela Wardell-Johnson. Their patience in explaining processes and approaches and their enthusiasm led me through an inspirational learning experience. Their support and advice during the writing period of the thesis was unconditional, consistent and encouraging.

I also acknowledge the support and advice John Noonan has given me during the last two years of writing and the opportunity to work on the WA Farm Business Resilience Pilot and apply and extend my research.

I extend my thanks to others such as Dr Anthony Hogan at ANU and Dr Ross Kingwell for the opportunities they offered in promoting my research. In addition, there are many other people at Curtin University and other universities and organisations in WA and around the country that because of space I am unable to individually acknowledge.

I am grateful to and especially thank the organisers of the Dowerin, Newdegate and Mingenew field days who not only allowed me to conduct the survey during the events but also promoted it. I am also indebted to my three friends: Eva Varga, Peter Gwynne and Daniel Hoare who helped collect the data. Without them there would have been many less surveys collected with a lot less humour.

Finally, I acknowledge the debt I owe my wife Sally and my children, Courtney, Josh, Brittany, Sam and Emily for their patience, understanding and encouragement. This journey would not have started or been completed without their support and love.

Preface

During the process of this study there have been a number of requests to present the research at a variety of forums. The opportunity to do so has provided positive feedback which has greatly assisted in formulating ideas and interpreting the results. Information and results arising from the research have been delivered through a combination of presentations, reports and papers.

The research was presented to the following conferences and seminars:

- "Attitudes to Climate Change." Evans, Storer and Wardell-Johnson: Rotary District 0450 Community Conference 2008–2009, Day 1, Sustainability; our people, our planet, our future: Joondalup Reception Centre, Joondalup, WA. October 2008.
- "Rotarians Responses to Climate Change, Comparing climate change responses of Rotarians to responses of rural people." Evans and Storer: Rotary District 0450 Community Conference 2008–2009, Day 2, Sustainability; our people, our planet, our future: Joondalup Reception Centre, Joondalup, WA. October 2008.
- "Rural Peoples' Attitudes to Climate Change." Evans, Storer and Wardell-Johnson: Greenhouse 2009, Climate Change and Resources, Burswood Convention Centre, Perth, WA. March 2009.
- "Climate Change Response in Rural WA; The role of government and scientists in adaptation." Evans, Storer and Wardell-Johnson: Climate 21, 'Understanding climate change and how to manage it', Department of Agriculture and Food, WA, Burswood Convention Centre, Perth, WA. March 2009.
- "Rural Peoples' Attitudes to Climate Change; The role of government and scientists in adaptation." Evans, Storer and Wardell-Johnson: Department of Environment and Conservation, Office of Climate Change, The Atrium, Level 4, Perth, WA. May 2009.
- "Rural Peoples' Attitudes to Climate Change." Evans, Storer and Wardell-Johnson: Centre for Advanced Studies in Australia, Asia and the Pacific, Faculty of Humanities, Curtin University, Perth, WA. August 2009.

- "Rural Western Australians' Responses to Climate Change." Evans, Storer and Wardell-Johnson: 'Changing Environment', Western Australian State Natural Resources Management Conference, Geraldton, WA. October 2009.
- "Climate Change Communication, Engaging science with the rural sector." Evans, Storer and Wardell-Johnson: National Forum, Understanding Rural landholder Responses to Climate Change, Charles Sturt University, Albury–Wodonga, NSW, November 2009.
- "Attitudes of farmers and industry to climate change and seasonal risk." Beard, Evans, Storer and Wardell-Johnson: Climate Science Update, Department of Food and Agriculture WA, Bentley, Perth WA. March 2010.

Reports prepared and submitted at the request of interested organisations:

- Evans, C. 2008, "Farmers' Responses to Exceptional Circumstances Assistance Policy", Preliminary report prepared at the request of WA Farmers CEO, Andrew McMillian.
- Evans, C., Storer, C. and Wardell-Johnson, A. 2009, "Sustainability: our people, our planet, our future", Summary report prepared for Rotary District Governor, Sue Rowell, Rotary District 9450.
- Evans, C., Storer, C. and Wardell-Johnson, A. 2009, "WA Agriculture Industry and Rural Community Representatives Views of Exceptional Circumstances Assistance Issues", Summary report prepared for The Western Australian Farmers Federation (WA Farmers) as part of the WA Farmers submission to the Productivity Commissions review of the Drought Assistance Policy.

Papers from the research submitted for publication and conferences:

- Evans, C., Storer, C. and Wardell-Johnson, A. 2009, "Climate Change Response in Rural WA: Rural peoples' attitudes to climate change, The role of government and scientists in adaptation", Proceedings Climate 21, 'Understanding climate change and how to manage it', Department of Agriculture and Food, WA, Burswood Convention Centre, Perth, WA.
- Evans, C., Storer, C. and Wardell-Johnson, A. 2010, "Rural Attitudes to Climate Change, A factor analysis of rural peoples' responses" under review.

- Noonan, J.D, Evans, C., Storer C.E, Bodman, K., Bessen B., O'Byrne, M., Burke, G., Quartermaine, M., McAlpine G.A., Foord, G., Cooke. P, and McConnell, C. 2012, "Reframing the future for farmers: a multidisciplinary facilitated strategic planning approach to mitigate threats to farm businesses", The Seventh International Conference on Interdisciplinary Social Sciences. Barcelona. June 2012.
- Noonan, J.D., Storer, C.E., Bodman, K., Evans, C., Bessen B., O'Byrne, M., Burke, G., Quartermaine, M., McAlpine G.A., Foord, G., Cooke. P. and McConnell, C. 2012, "Reframing the future for farmers: a multidisciplinary facilitated approach to addressing climate change", The Second Intentional Climate Change Conference. Seattle. July 2012.
- Wardell-Johnson, A., Ernoul, L., Evans, C. and Storer, C. 2013, "Climate change: Messages for applying communications of the science", Southern Connection Congress, 2013, Otago.

Information derived from the research including the survey questions and specific results have been shared with other researchers and used in research projects undertaken by:

- Department of Primary Industry, Victoria, 2010, Climate Project, "Understanding farmer knowledge and attitudes to climate change, climate variability and emissions trading", Future Farming, Productive, Competitive and Sustainable.
- Gray, D. 2009, "The known unknowns of climate change, Adaptation in the southern agricultural region of Western Australia", Department of Agriculture and Food, Katanning, WA.

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Chapter 1: Introduction

1.1 Background to the research

When initially considering a project topic for research it was suggested I examine the impacts Western Australian farmers thought climate change could have on their businesses. I felt the suggestion had merit given that the Australian Federal Government had accepted the scientific view that climate change represented a serious threat to the Australian agricultural and rural sector (Allen Consulting Group, 2005). Australia's peak farming representative organisation, The National Farmers Federation (NFF) (2006), publicly endorsed this view. It also appeared that agriculture was a major contributor to Australia's carbon emissions, accounting for 22% of total emissions (Agricultural Alliance on Climate Change (AACC), 2007). In short, Australian farmers and their businesses were being threatened by a problem that they through their farming activities had contributed to.

In response to the threat climate change potentially held for Australian agriculture, Federal Government scientific and industry agencies sought to promote adaptation and mitigation actions within agriculture to facilitate resilience in the face of climate change (Natural Resource Ministerial Council (NRMC), 2006; Hatfield-Dodds, Carwardine, Dunlop, Graham and Klein, 2007). Policy approaches to adaptation actions are focused on adapting agriculture to the expected impacts of climate change while mitigation policies address the causes of agricultural greenhouse emissions with the intention to reduce future greenhouse emissions (AACC, 2007; Garnaut, 2008). The AACC (2007) report also flagged the need to address the concept of "resilience building" in rural communities. The AACC (2007) report states:

> *"Resilience building aims to strengthen rural communities to better deal with climate change events as well as the longer term impacts of climate change."*

The Encarta Dictionary (2012) describes adaptation as being: "the process or state of changing to fit a new environment or different conditions or the resulting change." In the context of climate change response, the process of adaptation refers to the approach of modification or adjustment actions taken to enhance the resilience of natural and managed systems and limit the extent of damage caused to the systems by climate change (Scheraga and Grambsch, 1998). However, as Beddington et al. (2012) point out, there needs to be a common definition of how the term "adaptation" is applied to agriculture. To this end,

Beddington et al. (2013, page 290) suggested there were five elements that should be considered. These were:

- *"maintains or increases production of food, fodder, fiber or fuel"*
- *"supports livelihoods and builds prosperity"*
- *"sustains environmental resources and ecosystems"*
- *"adapts to existing and future climate*
- *"sequesters carbon and/or reduces Green House Gas emissions"*

These elements add detail to the Intergovernmental Panel on Climate Change (2001, page 982) general description of adaptation, which describes adaptive capacity as:

> *"The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, take advantage of opportunities or to cope with the consequences."*

Further to this, the Federal Government had signalled its commitment to bolstering agriculture's resilience with a significant distribution in the 2008 budget (Swan, 2008). The bulk of the budgetary provision of $2.25 billion was to be allocated over a five year period to funding for the "Caring for our Country" (2008) initiative. Significant policy investment did not allow for the risk that rural communities' perceptions of climate change would limit the value of the investment. In addition, there was a potential that a poor understanding of perceptions of climate change in rural regions would limit the effectiveness of policy uptake. Thus, research into the perceptions of the farming community in relation to climate change would make a significant contribution to ensuring effective policy implementation in addition to understanding the implications of mitigation and adaptation approaches for climate change management.

At the time I began to investigate the subject (December 2007-June 2008) through secondary research there was a profusion of research identifying the threat of climate change to the south western regions of Australia and to Australian agriculture (AACC, 2007; Allen Consulting Group, 2005; Gunasekera, Kim, Tullah and Ford, 2007; Hatfield-Dodds, Carwardine, Dunlop, Graham and Klein, 2007; Hennessy, Fitzharris, Bates, Harvey, Howden, Hughes, Salinger and Warrick, 2007; Kokic, Heaney, Pechey, Crimp and Fisher, 2005; Pittock, 2003). In addition, there were at least two reports which examined potential issues and implications for agriculture

and farm businesses arising from policy approaches to mitigation actions through "Emissions trading schemes" (Allen Consulting Group, 2006; Keogh, 2007). However, there appeared to be limited information addressing farmers' perceptions of climate change and the potential for climate change to be a threat to their businesses and communities.

Exploratory qualitative research addressed rural Western Australians' attitudes to climate change through a series of public forums in Perth and the five regional areas of Katanning, Ravensthorpe, Albany, Bunbury, and Geraldton by the Department of Food and Agriculture WA (DAFWA) (2006). The results (DAFWA, 2006) indicated that many people had noticed some changes in the climate and generally thought climate change was occurring, but were not certain if the changes were due to natural or human-induced causes. In addition, results indicated that most participants perceived climate change as an abstract future-orientated threat, and thought they had already adapted to changes in the climate. Although the DAFWA (2006) research was spatially extensive, only forty three people had participated in six public forums.

It was not until after I had commenced my research in July 2008 that published studies evaluating farming communities' responses to climate change in Victorian and NSW farming communities in the Murray Darling Basin became available (MDB) (Milne, Russell and Stenekes, 2008). This research provided some quantitative results based on a qualitative approach with a small sample (N=68).

My perception of the limited literature relevant to Australian farmers' perceptions of changes in the climate and attitudes to climate change prior to July 2008 were later confirmed by Stenekes in a presentation to "The National Forum: Rural Landholders Responses to Climate Change" (2009). In presenting the research results derived from the MDB study at the National Forum (Milne et al., 2008), Stenekes drew attention to the paucity of earlier research regarding Australian farmers' attitudes to climate change and the threat of climate change.

A range of considerations would provide insight into the influences that define perceptions of climate change. Initially I thought science and policy approaches in addressing the threat of climate change to agriculture were somewhat presumptuous.

The accumulating volume of valid evidence indicated an increasing level of confidence that the global climate was changing (Intergovernmental Panel on Climate Change (IPCC), 1990; IPCC, 1995; IPCC, 2001; IPCC, 2007), with serious implications for Australian agriculture and farmers (Hennessy et al., 2007).

The Australian Federal and State governments had accepted the information that science provided and the warnings of increased climate change threats to agriculture with the development of adaption and mitigation response strategies. However, it appeared there was little evidence of research into Australian farming and rural communities' attitudes to climate change to support the policy approach. Perceptions of threat/risk to businesses and communities' were poorly understood. When reading the literature I perceived an assumption on the part of scientists, policy advisors and a key farm industry organisation (AACC, 2005; Hatfield-Dodds et al., 2007; Hennessey et al., 2007; NFF, 2006; Pittock, 2003) that because science had identified climate change as a threat and was working with government to respond to the threat, Australian farmers would automatically accept climate change was occurring and was a threat.

The assumption that farmers would accept scientific information and acknowledge the need to adapt and accept privations incurred as a result of policy responses was something I questioned based on my own personal experience. I had left farming three years earlier in 2005 after 45 years of living on a farm and 28 years farming. I retained close personal ties with the farming community in which I had farmed, as well as contacts throughout WA agricultural regions and agricultural industry finance and service providers.

Certainly, global climate change was not a management or planning consideration for me when I was farming. Yes, I had noticed changes in the climate over the time I had lived and farmed in the area. I would have responded in a similar fashion to one of the farming participants I interviewed during the Familiarisation study who, when asked if they had noticed changes in the climate, replied:

> *"Of course it's changed. …it's always changing. We have had big 'dries' before back in 1940's and 1970's but then it turned wet again."*

Equally, my response to 'What do you think about climate change?' would have been similar to these responses participants gave:

> *"I think people are making a big thing out of it without really knowing what's going on"* or *"I haven't really thought about it."*

As a farmer in the early 2000's, issues of global climate change were of minimal interest. The only climate that mattered was the one affecting my farm. That climate and the knowledge I had drawn from personal and family experiences derived from an extended history in farming that drove my planning and decision-making processes.

Long and medium term approaches to farming systems, management, fodder conservation and storage were influenced by my father's and grandfather's experience with climate variability and drought. My grandfather's experiences during the "Federation drought" when feed was in such short supply farmers cut down trees or stripped the thatch from shed roofs to feed their precious working horses influenced my long-term practice of storing twelve to eighteen months of grain and fodder on-farm . My grandfather's experiences of an unprecedented drought which occurred in the early 1900's were passed to me via my father. When farming, I 'knew' the changes in climate in my local area were occurring because of 110 years of accumulated layers of personal and family experiences and not because the Bureau of Meteorology or a climate scientist 'from Canberra' said it was.

My questions if I had remained farming would be:

- Are changes in climate or global climate change a threat to the future of my farm business and local community?
- Is the warming/drying trend forecast by climate scientists for the south western regions of Australia, including the area where I farmed, serious (Hennessey et al., 2007; Pittock, 2003)?

I suspect my response may have been similar to that of a participant who was asked the question 'What do you think about scientists' warning that climate change could be a serious threat to the future?'

> *"It could be a serious threat, but there's probably as much chance it won't be. The weather or climate… is only one part of farming there are a lot other factors that affect the bottom line."*

Certainly, declining trends in late autumn and early winter rainfall and fewer heavy rainfall events during June and July were a concern. But there were benefits. Fewer wet seasons causing water logging had resulted in increases in grain yields and an expectation of grain harvest or hay from every hectare sown unlike my father, who from the 1950's to mid-1970's expected to lose at least 10-15% of his crop to water logging almost every year.

In the preliminary stages of the research I spoke with five farmers of personal acquaintance about the decreased growing-season rainfall and lower frequency of wet seasons. The discussions with these farmers centred on the question: 'Is the decrease in rainfall and fewer wet seasons a concern?' The consensus was that lower rainfall in combination with new technologies was proving to be a major benefit.

These first informal discussions with farmers revealed some scepticism around the topic of climate change and the potential threat of climate change to agriculture. The farmers I spoke to were not overly worried about climate change and were dismissive of science's warnings of more extreme climate/weather events and increased climate variability, as well as the Federal Government's initiatives to promote adaptive responses, as they believed they were and always would be adapting to changes in the climate. As far as these farmers were concerned, drought, flood, frost and fire with climate variability were accepted features of farming in the southern agriculture regions of WA.

The idea that these changes were due to something other than natural influences on the climate was barely considered by the farmers. Several were quick to point out major volcanic eruptions such as the Mount Pinatubo (Philippines) eruption in June 1991 decreased average global temperatures for several years. An observation confirmed by research which reported that almost 20 million tons of sulphur dioxide forced into the stratosphere and dispersed around the globe reduced global temperature by 0.4 to 0.5°C from the time of the eruption in 1991 until 1993 (Rosenberg, 2010). These conversations offered strong evidence about information

sources for climate change that were not those promoted by government agencies or conventional climate change science.

The discussions with the farmers indicated that they accepted the climate was changing but in a local context, and not global. These farmers also expected that the climate was always changing and seasonal variability, droughts, floods, frosts and fires were considered a normal part of the farming environment. The idea that climate change was human-induced and a threat were barely considered. I did, however, note that climate change had developed a higher profile as a topic among farmers during the early stages of 2008 compared to when I left farming in 2005.

The anecdotal evidence I had gathered from my discussions with the farmers was in part supported by Milne et al.'s (2008) research of farming communities in the Murray Darling Basin (MDB). These results indicated that only 36% of participants in the study (N=62) thought climate change was occurring, whereas 39% were uncertain or did not know and 11% disagreed it was occurring. Of interest was the 14% who agreed climate change was occurring but thought that it would not affect their region. Only 21% of participants thought climate change was 'Manmade' and 10% thought it was 'Natural', while 10% were 'Uncertain' and 59% did not respond to the question.

Given these responses, participants' perceptions of expected impacts of climate change indicated at best relatively high levels of concern, and at least, a poor knowledge of the issues. Well under half (42%) 'Expected impacts of climate change on businesses, organisations and the community' would be 'Significant', and 20% expected impacts would be 'Moderated by adaptation'.

The MDB study (Milne et al., 2008) and my discussions with farmers suggested a lack of congruency between farmers' perception of climate change risk and that of science and government. It seemed many farmers did not perceive climate change as the threat that climate scientists and policy makers' indicated. Similarly, DAFWA (2006) research indicated a widely-held perception of climate change as an abstract threat/risk in the future. These perceptions substantiated Kingwell's (2006) warning that farmers' knowledge and perception of risk derived from managing seasonal variability. Kingwell (2006) indicated that the farming community's ability to

manage seasonal variability rather than being an advantage could be a liability in their decision-making processes in response to climate change.

The potential for a lack of congruency between farmers' and scientists/policy makers' views on climate change and climate change threat appeared to have been anticipated by the authors of the "National Agriculture and Climate Change Action Plan 2006–2009" (NACCAP, 2006–2009) (NRMC, 2006). The NACCAP, 2006–2009 was developed to manage the multiplicity of threats of climate change to the sustainability of agriculture.

Embedded among the various strategies and actions outlined in the plan to address agricultures' adaptation to climate change was a section titled 'Awareness and Communication'. Two strategies and accompanying actions in this section specifically targeted the communication of scientific information about climate change risk to all stakeholders in agriculture to facilitate integration of climate change information in stakeholders' decision-making processes.

Of particular relevance to this research were 'Strategy 4.1' and 'Strategy 4.3'. The broad aim of Strategy 4.1 was to: "Ensure climate change issues are integrated, where relevant, in policy and programme communications." The individual 'actions' comprising Strategy 4.1 were:

> *4.1.1 Identify priority industries and groups to target communication messages.*
>
> *4.1.2 Assess the level of understanding of climate change issues in rural industries and identify barriers to communication.*
>
> *4.1.3 Identify priority messages to increase climate change awareness amongst stakeholders.*

Strategy 4.3 specifically identified priority processes to be utilised to increase climate change risk awareness within the agricultural sector. The aim of strategy 4.3 was to: "Incorporate issues of climate change into education and training packages directed at agricultural industries". The actions designated to achieve this aim were to:

> *4.3.1 Identify and develop key information, education and training channels such as media, education, training and extension networks.*

> *4.3.2 Identify and develop mechanisms for raising awareness leading to attitudinal, behavioural and practice change through developing partnerships by partnering with industry and community.*

The developers of the NACCAP 2006–2009 (NRMC, 2006) acknowledged the potential for stakeholders in the agricultural industry not to recognise or to underestimate the threat climate change represented for the industry. Essentially, the key objective of these strategies was to ensure through the transfer of climate change threat information to the agriculture sector that all stakeholders would have an increased awareness of the threat.

It has been proposed that motivation to adopt underpins the adoption (adaptation) diffusion process (Pannell et al., 2006; Rogers, 2003). The motivation to adopt is initially promoted by the non-trial evaluation of a need to adopt/adapt (Lindner, 1987; Pannell et al., 2006).

The responses of the farmers I spoke to and results of Milne et al. (2008) and DAFWA's (2006) research suggested motivation for farmers to undertake adaptations in response to climate change threat was limited. If this was the case throughout Australian farming communities, Australian agriculture could become increasingly vulnerable to climate change. Additionally, government funding of $2.25 billion for climate change initiatives announced in the 2008 budget (Swan, 2008) for public policy programs such as the "Caring for Our Country" (2008) could have limited impact.

A crucial point in understanding farmer's attitudes to climate change threat/risk was understanding what influenced their attitudes. Research has proposed risk/threat perception is a socio-cultural construct (Covello and Johnson, 1987). That is, the level of risk/threat is delineated in a societal context within a framework of socio-cultural beliefs, values, history, traditions and knowledge which define acceptable limits of averseness or tolerance to risk.

In addition, research indicates that the inherent beliefs and values of socio-cultural structures such as family, community, religions, politics and race shape individual attitudes and behaviours (Fishbein and Ajzen, 1975; Stern and Dietz, 1994; Taylor-Gooby and Zinn, 2006). Therefore differences in perceptions of risk/threat could be

expected between the various social structures of the broader society. It is these differences which, in the diffusion of risk information, may lead to "Epistemological Distances" between the social structures of scientists, policy makers and the public (Garvin, 2001).

Epistemological distances are essentially as Cash et al. (2002) proposed the fundamental differences between the relevance and importance each social structure ascribes factors of risk/threat. For example, WA farming and rural social sectors may have a low perception of threat/risk because of an inherent tolerance of climate threat/risk due to the high variability in the WA climate. Conversely, science and policy makers' perceptions of climate change threat/risk may be conceptualised in a different social framework of values and beliefs drawn from a broadview perspective of evidence and potential impacts on a national and international scale. Therefore if farmers and people within the broader agricultural sector do not perceive climate change as a threat/risk the motivation to adapt does not exist. If there is a lack of climate change risk/threat awareness, then the first stage of the adoption/adaptation process of non-trial evaluation, recognised by research as crucial to identifying a need or problem, may not occur (Linder, 1987; Pannell et al., 2006).

Vanclay (2004) describes the adoption/adaptation process of Australian farmers as a socio-cultural process because farming is a socio-cultural practice. Vanclay (2004) maintained farmers constructed their own knowledge and, as such, did not grant scientific knowledge or information automatic validity. If this is the case, then the "Awareness and Communication" strategies and actions proposed in the NACCAP 2006–2009 policy (NRMC, 2006) to increase awareness of climate change threat among stakeholders in agriculture was dependent on understanding farmers and other rural social structures' perceptions of climate change threat/risk attitudes.

Milne et al.'s (2008) results recommended that more research on farmers' perceptions of climate change is needed to define the concept of adaptive capacity and the place adaptive capacity has in influencing rural peoples' perceptions and responses to climate threat/risk.

The difference between the scientific/government approach to the threat of climate change and the ambiguous responses of rural people raised a series of questions for

further research. These questions were necessary to justify policy investment in climate change adaptation approaches in Australian agriculture. For example:

- What do rural people think about climate change?
- What is influencing rural peoples' perceptions of climate change risk?
- Are there major differences in rural peoples' understanding and knowledge of climate change compared to science and policy understanding and knowledge of climate change?
- If there are differences, what are the sources?

These four questions framed the focus of my research on "Rural Western Australians' attitudes to climate change, climate change science and role of government in climate change".

Chapter 2: Literature Review

2.1 Chapter Outline

Scientific evidence strongly suggests that climate change will affect all global regions but that there will be a variance in the changes and the level of impact affecting various global regions (Alcamo et al., 2007). Similarly, changes in Australia's climate and potential impacts would vary, with areas in south western regions of Australia becoming dryer and warmer and northern areas experiencing more tropical storms and intermittent flooding (Hennessy et al., 2007).

This chapter reviews the literature concerning international and Australian urban and farming communities' attitudes to climate change and climate change threat (Sections 2.2 to 2.4). Then some personal and socio-cultural beliefs and values which influence attitudes to climate change are examined in Section 2.5. Section 2.6 gives an overview of "experts" credibility issues with the public, followed by Section 2.7, which explores the communication of climate change information and knowledge by media outlets and science, and government information/knowledge sources.

2.2 An overview of global attitudes to climate change

Climate change has been described as the world's greatest challenge in the twenty first century (Fry, 2008). Scientists propose changes in climate have been outside accepted ranges of variability and are occurring at faster than expected rate (Pittock, 2003). The primary cause of this has been attributed to emissions of greenhouse gases as a result of human activity. It is asserted that the accelerated rate of climate change will challenge humans' capacity to effectively adapt, and put at risk global managed and natural environments (Intergovernmental Panel on Climate Change (IPCC), 2000).

Despite the scientific review of evidence concerning climate change, there remains uncertainty and divisiveness within the global scientific community as to its causes and potential outcomes. Scientific monitoring and studies show that solar forcing and storms, changes in the earth's orbit around the sun (United States Environmental Protection Agency (EPA), 2012), in addition to volcanic activity (Robertson,

McKenna, Toon, Hope and Lillegraven, 2004) can all influence the global climate. Other research argues that changes in climate are within accepted historical ranges of variability (Loehle, 2007). Furthermore, Avery (2008) maintains that food production and the natural environment would benefit from increasing levels of atmospheric carbon. Research into atmospheric carbon's fertilisation properties for wheat suggests this outcome may be possible (Asseng, Jamieson, Kimball, Pinter, Sayre, Bowden, and Howden 2004).

The divisiveness within the scientific community has also been reflected in government's approach to climate change. In 1997, 184 sovereign states ratified the Kyoto Protocol (1997) and invoked an agreement to reduce current and future greenhouse emissions (United Nations Framework Convention on Climate Change, 1997). Australia did not become a signatory until 2007 (Grubel, 2007) as the previous Liberal/National government led by Prime Minister John Howard initially refused to ratify the Kyoto protocol (Hamilton, 2004).

Despite the Howard Government's refusal to sign the Kyoto Protocol, a number of Federal and State government climate change initiatives were implemented. These included commissioning of studies and reports detailing climate change impacts and potential strategic responses for the Australian agricultural sector (Agricultural Alliance on Climate Change, 2007; Gunasekera, Kim, Tullah and Ford, 2007; Hatfield-Dodds et al., 2007).

However, at the same time other research showed that despite government's acceptance of science's warnings about climate change threat and the need to respond, public perceptions of climate change in Australia and throughout global communities remained ambiguous. Earlier UK and American research into largely urban populations indicated that there were high levels of uncertainty, doubt and indecisiveness about climate change and its causes (Bord, Fisher and O'Connor, 1999; Langford, 2002; Lorenzoni and Langford, 2001; Van Dommelen, 1999) (See Appendix 1 for a more detailed description of the research and results).

It was found in these and other studies that this uncertainty, doubt and indecisiveness both characterised and influenced people's perception of the threat and risk associated with climate change (Bord et al., 1999; Bord, Fisher and O'Connor, 1998;

European Opinion Research Group, (EORG) 2002; Langford, 2002; Lorenzoni and Pidgeon, 2006; OST/MORI, 2004; Sustainable Energy Coalition, 1996).

Several of these studies showed that climate change threat/risk was regarded as a very low priority in comparison to other issues including the environment, family, safety, children, education, health, finances and terrorism amongst many other issues (EORG, 2002 ; Dunlap and Saad, 2001; Norton and Leaman, 2004; Poortinga and Pidgeon, 2003a). The research indicated that the low priority attributed to climate change may have been derived from either a limited or flawed understanding or knowledge of the topic (Berk and Schulman, 1995; Bord et al., 1998; EORG, 2002; Kempton, 1993; Leiserowitz, 2006).

In addition, a UK review suggested that the public's lack of understanding about the causes of climate change could cause issues in the transfer of information and knowledge between science and the public (Anable, Kelay and Lane, 2006). Although the scientific evidence supporting climate change had continued to mount over time (IPCC Third Assessment Report, 2001; IPCC Fourth Assessment Report, 2007), it appeared to have little influence on the public's perceptions of climate change threat (Anable, Kelay and Lane, 2006).

To address this issue, the UK review of the public's attitudes to climate change proposed engaging the public in an iterative interactive approach facilitated by developing social profiles of people's values and beliefs associated with their behaviours (Anable, Kelay and Lane, 2006).

2.2.1 Social profiling of the public's climate change attitudes

A later American study did this by social profiling of participant's climate change attitudinal characteristics (Maibach, Roser-Renouf and Leiserowitz, 2009). In developing the social profiles the research explored what factors influenced participants' attitudes. These factors included:

- Socio-demographic characteristics of: age, gender and education
- Beliefs
- Risk perceptions

- Response attitudes
- Priority issues
- Achievability of emissions reduction
- Political and consumer activism
- Policy preferences
- Information requirements
- Perceptions of climate change messengers (science, policy, media and local/personal information networks)

Results showed that 57% of participants believed global warming was human-induced and 33% thought it was natural. Five percent thought it was derived from both human and natural activities and three percent maintained it was not happening. However, only 18% were alarmed and 33% concerned, while 19% were 'cautious' about climate change.

The research (Maibach et al., 2009) identified six different climate change social profiles or typologies: 'The Alarmed'; 'The Concerned'; 'The Cautious'; 'The Disengaged'; 'The Doubtful' and 'The Dismissive'. In addition, this research identified sets of socio-demographic characteristics and values associated with each of the six different responses. (A full description of these social profiles or typologies is available in Appendix 2).

To broadly summarise attributes of the social profiles:

'The Alarmed' tended to be females; older/middle aged (55-64 years old), well-educated with higher incomes and Democrats. They exhibited strong community and social justice values and government support of the basic needs of all citizens and valued the natural environment as more important than economic growth and were willing to change behaviours and personally in response to climate change.

'The Concerned' were representative of the gender, age, income, education and ethnicities of American society. They tended to be community-minded and moderate Democrats who held moderate egalitarian standards. They also favoured the

environment over economic growth but thought government, industry and science bore the responsibility for responses to climate change.

'The Cautious' were of mixed political allegiances and held 'traditional religious beliefs' (as opposed to Evangelical Christian or other religious beliefs). They were less community minded than the 'Alarmed' or ' Concerned' and were not inclined to take action or support government climate change mitigation legislation.

'The Disengaged' tended to be females from minority cultures with lower levels of education and income. They held egalitarian values along with conventional religious attitudes and were moderate Democrats who favoured economic growth over protection of the environment. The 'Disengaged' were also more likely to change behaviours or support government legislative responses to climate change.

'The Doubtful' were more likely to be better educated individualistic white older males with higher incomes and a conservative disposition towards religion and politics. Their community involvement was rated as 'average' and they supported economic growth over protection of the environment and were less likely to engage the climate change problem or support government intervention.

'The Dismissive', also tended to be white, individualistic, well-educated males with above average income with conservative Republican views and traditional religious beliefs who opposed egalitarianism and government intervention in any form including responding to climate change. As with 'The Doubtful', 'The Disengaged' and 'The Cautious', 'The Dismissive' was also not inclined personally engage in behavioural changes.

In addition, Maibach et al. (2009) identified communication and receptiveness of scientific climate change information as an issue. As with the EORG (2002) study, only 18% of respondents thought they were 'very well informed' and 22% thought they needed a little more information about global warming. In contrast, 30% required 'a lot more information' and 30% wanted 'some more information'. Yet just 12% of respondents indicated they paid 'a lot of attention' and 30% 'some attention' to information about global warming.

As far as climate change science was concerned, Maibach et al.'s (2009) research showed there were issues with the credibility of science. While 47% of respondents believed most scientists thought global warming was happening, 33% felt 'There was a lot of disagreement' about climate change amongst scientists. Additionally over half (54%) indicated they 'somewhat trusted scientists' as sources of global warming information whereas only 29% indicated they 'strongly trusted' scientists.

As with other studies, global warming as an issue was ranked below other policy issues such as health care, terrorism, social security, education, tax cuts and illegal immigration (Bord et al., 1998; Dunlap and Saad, 2001). Only 21% of respondents in Maibach et al.'s (2009) research believed global warming was an important issue, although its importance as an environmental issue had increased when compared to Dunlap and Saad's 2001 study.

The earlier studies (Bord et al., 1998 and 1999; Dunlap and Saad, 2001; Langford, 2002) and Maibach et al.'s (2009) social profiling of Americans' climate change characteristics and values illustrated that perceptions of climate change were not simply issues of awareness or belief that it was occurring, or was a threat. Layering of socio-cultural values and beliefs across socio-economic demographics demonstrated that there was a multifaceted series of interdependent relationships and conflicts underlying attitudes to climate change, perceptions of threat and peoples' core beliefs and values. As described later in the review, these interdependent relationships are important considerations when examining farmer's attitudes of climate change and their perceptions of climate change threat.

It could be argued that the responses regarding priority and perceptions of climate change threat and acceptance of 'expert' risk communication were linked to people's receptiveness of risk based on their knowledge and experience. Other American research supported this argument by demonstrating disparities between the perception of climate change risk and receptiveness of 'expert' information (Zahran, Vedlitz, and Grover, 2008). This research showed that people who had been coastal residents for shorter periods of time had higher risk sensitivity to climate change because they lacked extensive experience in that particular environment. As a result, they were more receptive of 'expert' information which emphasised the threat of rising sea levels to coastal communities. Conversely, long term residents of

communities on a coastal hundred-year flood plain displayed very low risk sensitivity to the climate change threat identified by experts. Other research demonstrated that responses to natural extreme climatic events showed past experience of similar events had led to groups of people underestimating the extent of potential threat and impacts to themselves and their property (Adeola, 2009). This introduces a very important point of the influence of experience of an activity in people's perception of climate change threat/risk in regard to farmers. This will be elaborated on further later in the chapter.

In essence, results of previous research suggested that what influences the public's response to climate change and climate change threat is as complex as the issue of climate change. The research demonstrated that public perceptions of climate change and climate change threat were being framed within a series of socio-cultural, bio-physical and economic contexts. Results of Australian research indicated similar responses despite Australia being identified as among the countries that would be highly vulnerable to climate change (Hennessy et al., 2007; Pittock, 2003).

2.3 Australian attitudes to climate change

Australian attitudes of acceptance to global climate change were shown by research to be more reserved and in some instances tended to vary widely. This could be regarded as surprising given the country's high vulnerability status to climate change (Hennessy et al., 2007).

A Newcastle study (n = 242) by Buckley (2000) comprising 50% adults and 50% adolescents aged 11–12 and 16–18 showed elements of acceptance and uncertainty. While 45% of respondents were certain that climate change was occurring and only 1% disagreed, 52% exhibited varying degrees of indecision. Flawed knowledge was found to contribute to the indecision as shown by the 35% of respondents who thought the ozone layer caused climate change.

The confusion about climate change and its causes Buckley (2000) concluded were derived not only from flawed understanding but also a different understanding of the issue as demonstrated in other research (Adeola, 2009; Zahran, Vedlitz, and Grover, 2008). The suggestion was that people viewed climate change as a representative not isolated problem of the interdependence between the environment and society. This

included socio-ecological relationships and the relationships between the public and 'experts,' as well as local and international communities.

In addition, Buckley's (2000) study found that some focus group participants , while exhibiting faith in science as a dependable source of information, still had perceptions of scientific uncertainty and scepticism. Although 45% of participants: 'Definitely thought the greenhouse effect' was happening now, only 38% were positive about the information received, while 35% were indifferent to the information received. However, the intrinsic and extrinsic factors influencing these responses were not examined in the research.

Although Buckley's (2000) research acknowledged linkages between participants' climate change values and their personal beliefs/values with the information they received and processed, it did not delineate differences between the groups. For instance, information sources valued by respondents who thought the greenhouse effect was either 'definitely' or 'almost definitely' happening were not examined.

Alternately, McCrindle's (2008) research illustrated that generally Australians were convinced climate change was occurring. Results showed that of 1300 respondents, females (98%) and 18-28 year olds (91%) were the most concerned. Overall, 40% believed climate change would have an 'extreme' impact on Australia but older generations were less convinced about climate change. It was thought this was due to broader life experiences of crisis which had failed to fully eventuate, such as the Cold War and bird flu.

In contrast, Ipsos-Eureka Social Research Institute's third annual Australian climate change survey (2009) (N 1048) found 28% of respondents seriously doubted climate change was occurring. This was slightly lower than in 2008 when 32% doubted climate change was occurring. However, the researchers questioned if this was a shift in attitude to climate change or a shift in attitude of climate change deniers. In 2009, 14% of respondents identified natural climatic cycles as the major cause of climate change, up from five percent in 2006.

The research also reported that there were few signs to indicate that people were changing behaviours to reduce their carbon footprint. However, it was noted that people who believed climate change was human-induced were more likely to reduce

their personal environmental impact. It was therefore suggested that education about the causes of climate change was the key to increasing 'positive behavioural change'.

However, other studies suggested that education could be limited when applied to people who believed climate change was natural or were uncertain of the causes. The issue as a whole appeared to be less about what people thought or believed and more about understanding what influenced their beliefs.

A New South Wales study (N=634) to gauge peoples' responses to a Climate Pollution Reduction Scheme (CPRS) showed only 12% of participants ranked climate change as the most important policy issue in Australia (Akter and Bennett, 2009). As with the American studies, the economy, health care and education were ranked ahead of climate change. Uncertainty and doubt again characterised responses. Although 20% of participants were 'highly concerned' and 40% were 'concerned' about climate change, just 30% were only 'somewhat concerned' and 10% 'a little' or 'not at all concerned'. Equally, only 27% were certain human activity was causing climate change; while 49% were only 'somewhat' convinced human activity might be the cause.

These results indicated that people's perceptions of climate change threat were reduced if uncertainty was present. Support for a CPRS, Akter and Bennett (2009) concluded would be limited until there was greater certainty in climate change threat/risk forecasts. In addition, it was found many participants did not think a CPRS would contribute to slowing the rate of climate change. However, factors of trust and credibility with science and policy that may have influenced participants' willingness to support a CPRS were not examined in the study.

The uncertainty and doubt exhibited in the research did not reflect science's concern regarding Australia's increased vulnerability to climate change (Hennessey et al., 2007). Fewer Australians appeared to be 'alarmed' by climate change compared to Americans in Maibach et al.'s (2009) research. However, there was another population in Australia which Hennessey et al. (2007) identified as highly vulnerable to climate change. This was the farmers and rural communities throughout south western regions of Australia. In the next section the research and literature reviewed

will examine studies of international and Australian farming communities' responses to climate change.

2.4 Farmers and rural communities' perceptions of climate change

It has been projected that most agricultural regions around the world will have to adapt to climate change to ensure economic and productive sustainability (IPCC Fourth Assessment Report, 2007). It is anticipated this will vary from region to region.

Adaptations in European regions (Alcamo et al., 2007) and north eastern Africa (Boko et al., 2007) will be in the type of crops produced and/or spatial regional changes of traditional agricultural systems that may not ultimately affect production or economic capacity.

However, Australia southern agricultural regions and Africa (with the exception of north eastern regions) have been identified as highly vulnerable to climate change (Hennessy et al., 2007, Boko et al., 2007). These forecasts are influenced by existing trends of decreased rainfall and increased temperatures, in association with increased seasonal variability, (IPCC Fourth Assessment Report, 2007; Indian Ocean Climate Initiative (IOCI), 2004).

Studies have shown farmers in Mozambique (Patt and Schroter, 2008), Britain (Holloway, 1999), the Himalayas, Nepal (Dahal, 2006) and the Limpopo Basin, South Africa (Gbetibouo, 2008) had noticed distinctive changes in their regional climates. The changes have been observed over an extended period of time and farmers have been implementing adaptive strategies where possible (Holloway and Ilbery, 1996; Dahal, 2006; Gbetibouo, 2008).

The Mozambique study (N=84) found 90% of farmers had noticed major changes in temperature, cyclones, rainfall, soil moisture and flooding, which 45% thought would 'definitely continue' and 39% thought 'might continue'(Patt and Schroter, 2008). UK farmers had noticed increases in summer and winter temperatures (Holloway, 1999). Highland residents of Manang (Himalayas) believed monsoon intensity and rainfall volume had increased and farmers in the neighbouring region of Mustang knew the climate had changed because they could grow vegetables and

fruit they had previously been unable to grow (Dahal 2006). In addition, 95% of farmers in the Limpopo Basin study (N=686) had noticed long term increases in temperature and 97% had noticed decreased rainfall (Gbetibouo, 2008). Almost 30% had undertaken some form of adaptation in response to these changes.

Holloway (1999) and Gbetibouo (2008) concluded that the farmer's adaptive actions were primarily in response to short term agronomic-climate imperatives and not climate change threat. It appeared the farmers in the studies did not perceive future climate change as a threat because they believed that in their experience they had the capacity to adapt to any changes. Additionally, other research indicated farmers in developing nations felt that risks associated with markets and policy interventions were more important than future climate change threat (Patt and Schroter, 2008).

There was also evidence farmers' attitudes to climate change were influenced by perceived benefits created by the change in climate. Farmers in the Himalayas and UK viewed milder winters, warmer growing seasons and fewer frost events as an opportunity to grow higher-value crops (Holloway and Ilbery, 1996; Dahal, 2006).

The perception of benefits derived from climate change poses a conundrum for those agencies communicating the threat and risk associated with climate change. If farmers perceive climate change as beneficial, then how does more education about climate change and improved certainty of forecasts influence changes in attitudes and behaviours?

It seemed Australian farmers held similar views to their northern hemisphere counterparts despite the projections of increased climate risk to Australian agriculture. An Australian Bureau of Statistics (ABS) (Pink, 2008) survey of 150403 agri-businesses showed that 66% of Australian farmers had noticed changes in the climate and 62% believed the changes had impacted on their properties. Decreases in rainfall had been noticed by 92% and 74% had noticed increases in extreme weather events, while 50% believed the climate was warmer. In response, 48% of the agri-businesses had changed management practices. Most farmers believed they had adapted to the changes and in some areas the changes were viewed as beneficial such as WA where 20% of agri-businesses reported an increase in production.

An assessment of climatic conditions at the time of the ABS survey reported that areas of Victoria and Tasmania had recorded the driest second half of the year on record with eastern regions of Victoria affected by very heavy rainfall and widespread flooding (Bureau of Meteorology, 2011). It was also reported that agricultural areas around Geraldton, WA, had recorded below average rainfall and in some areas record low rainfall (Department of Agriculture and Food WA (DAFWA), 2007).

Critically, the ABS survey (Pink, 2008) had not asked farmers if climate change was natural or human-induced. Neither had the research clarified if changes in management practices were in response to perceived temporary or more permanent changes in climate. That is; did the changes in climate represent a long term shift in climatic/ecological systems which would necessitate transformative change as had occurred in the Goulburn-Broken Catchment (Walker et al., 2009)? Or were farmers responding to context-specific conditions influenced not only by changes in the climate but also broader economic factors and policies (Allison and Hobbs, 2004)?

Other research across Australia indicated farmers and rural communities were largely uncertain about climate change and the potential threat it represented. Exploratory qualitative research in WA suggested most rural Western Australians thought climate change was a future-orientated threat that would be addressed when the need arose (DAFWA, 2006). The research conducted via public forums in Perth and five rural/regional locations of: Katanning; Ravensthorpe; Albany; Bunbury; and Geraldton found there was an acceptance of climate change but uncertainty if it was natural or human-induced. However, the research was limited by its qualitative approach and small sample size (N=43).

Tasmanian research (N=62) also found that while 77% farmers/agribusiness participants thought that climate change was occurring, 34% were unsure of what was causing it and only 19% believed it was human-induced (Fleming and Vanclay, 2009). Alternately, only 36% of participants believed climate change was occurring in Milne et al.'s (2008) study of several Victorian and NSW rural communities in the Murray Darling Basin (MDB) (N=81), while another 24% thought it might be occurring and 15% did not know if it was occurring. This was despite an unprecedented prolonged period of very dry conditions in the area. Several farmers

viewed the extended dry as part of a natural cycle and expected the climate to return to what was considered normal for the area.

These perceptions and expectations were captured in comments of a farmer from the Birchip region which had been affected by drought for ten years:

> *"I cannot say that this last 10 years has been a result of climate change. It's a result of climate variability. We've had similar periods to this in the last hundred years…at least two…so I'm a firm believer that we'll go back to having good times again. But I do also believe that climate change is a fact of life."*

(Australian Broadcasting Corporation, 2008).

The MDB study (Milne et al., 2008) and Tasmanian study (Fleming and Vanclay, 2009) provided some of the first definitive perspectives of Australian farming communities' attitudes to climate change and climate threat. The studies, while limited in their qualitative approaches and small sample size to develop detailed social profiles of attitudes, provided sound conceptual basis for future research.

The research indicated that farmers, whether they were from Australia, Nepal, Mozambique or the UK, were mostly aware of changes in the climate and somewhat aware of climate change. However, their awareness had not necessarily increased their perception of the future threat/risk associated with climate change. Generally, the farmers in the studies were largely ambivalent about the forecasted impacts of climate change. It could be concluded that farmers largely viewed climate change as a problem that could and would be addressed.

However, most of the research focused on what people believed or thought about climate change without examining socio-cultural influences, which Maibach et al. (2009) showed also affected attitudes and perceptions. Maibach et al.'s (2009) examination of broader socio-cultural influences within the American population drew out associations of characteristics and climate change values with six distinct climate change typologies. The studies of Australian farmers also indicated that climate change values may have been bound within socio-cultural contexts.

There is a growing acknowledgement in Natural Resource Management (NRM) that promoting effective strategies is reliant on exchanges of relevant information

structured on socio-cultural, bio-physical and economic frameworks (Cary, Webb and Barr, 2001; Vanclay, 2004). The capacity to identify environmental typological characteristics of landholders is being recognised by researchers and NRM practitioners as a more viable approach in the delivery of NRM/agriculture development policy programs in Australia (Bohnet, 2008; Emtage and Herbohn, 2011). Likewise, identifying typological characteristics of farmers' attitudes to climate change may also facilitate climate change communication and knowledge transfer between science/policy agencies and farmers, which may promote adaptive change.

Research proposes that perceptions of risks and threats are a socio-cultural construct (Covello and Johnson, 1987). The following section examines the relationships between values, beliefs and the socio-cultural contexts which contribute to shaping peoples' attitudes. This is intended to provide a basis on which to explore the intrinsic cognitive influence that peoples' values and beliefs have in their conceptualisation of climate change.

2.5 Beliefs, values and the forming of attitudes

Beliefs can be defined in a number of ways as shown in the Oxford Dictionary (http://www.oxforddictionaries.com/definitions):

- an acceptance that something exists or is true, especially one without proof*: his belief in extraterrestrial life [with clause]:a belief that climate can be modified beneficially*
- something one accepts as true or real*; a firmly held opinion: we're prepared to fight for our beliefs [mass noun]:contrary to popular belief existing safety regulations were adequate*
- a religious conviction*: Christian beliefs [mass noun]:the medieval system of fervent religious belief*

The Free Dictionary, available at www.thefreedictionary.com/Beliefs, perhaps summarises these definitions with the definition:

- *Something believed or accepted as true, especially a particular tenet or a body of tenets accepted by a group of persons*.

On the other hand, values in the sense of personal values were defined in the Oxford Dictionary (http://www.oxforddictionaries.com/definitions) as:

- principles or standards of behaviour; one's judgement of what is important in life: *they internalize their parents' rules and values*

However, Schwartz (2009) links values intrinsically to beliefs in describing them as: "…tied inextricably to emotion, not objective, cold ideas". Schwartz (2009) goes further in saying that: "values are a motivational construct" that are used in selection and evaluation processes of behaviours, activities, policies and other people. But perhaps Schwartz's (2009) most relevant description in terms of this research is: "Values are ordered by importance relative to one another. People's values form an ordered system of value priorities that characterize them as individuals. This hierarchical feature of values also distinguishes them from norms and attitudes."

It has been proposed that the most stable intrinsic beliefs and values which tend to be resistant to change are formed early in life within the context of family socialization (Stern and Dietz, 1994).

Attitude has been characterised as 'an evaluative meditative response' which generates an evaluative reaction that will occur repeatedly if it is positively reinforced (Fishbein and Ajzen, 1975). Conventional psychology theory describes this as the "cognitive/learning" perspective, which is based on an assumption that people are generally capable of rational choice within the limitations of their reasoning and learning abilities within their experiences and circumstances in which they live (Taylor-Gooby and Zinn, 2006).

Some research proposes that risk sensitivity is conceptualised within socio-cultural and moral contexts within accepted socio-cultural norms that either overstate or understate threat, (Covello and Johnson, 1987). In addition, Sjoberg (2001) proposes that an individuals' perception of risk is based on their own specific beliefs and values as well as social-cultural values.

Thus familiarity with an activity determines risk tolerance or sensitivity to the activity. However, sensitivity of risk can also be influenced by the acceptance and necessity of an activity believed to be integral in meeting the daily needs of the

individual (Borgida and Campbell, 1982) and/or the potential for significant benefit from the activity (Siegrist and Cvetkovich 2000). So it could be said that attitudes form under this guise of interactive reinforcement of beliefs and values between social structures and the individual.

2.5.1 Uncertainty, heuristics and risk sensitivity

Within the unpredictability of life and ever changing nature of society, people face not only the unknown and unfamiliar, but also risks emanating from the progress of change. Nowotny, Gibbons and Scott (2001) describe new technologies and ideas as adding to uncertainty by confronting established processes. But as Marjolein, Van Asselt and Vos (2006) noted, risk and uncertainty, although not the same, are related.

To reduce the complexity of the uncertainty, Tversky and Kahneman (1972) observed that people use heuristics (rule of thumb estimations) by assigning predictive values to simplify judgment processes. Tversky and Kahneman (1972) proposed heuristics were derived from personal beliefs and values which contributed to forming attitudes. However, personal beliefs are largely subjective and speculative in nature, which can lead to personal bias and result in bias error. Barnes (1984) noted that although heuristics were at times useful, cognitive biases when used in risk perception processes could result in poor decision making and negative outcomes.

The heuristic function characteristics, mainly accepted as influences of cognitive biases, are described by Tversky and Kahneman (1972) as 'availability' and also 'anchoring and adjustment'. Each are recognised as a separate characteristic but generally function collectively during heuristic processes.

The heuristic that Tversky and Kahneman (1972) believed was a significant influence on peoples' perception of risk was 'availability'. Availability is structured on the capacity to easily recall a similar event. The recall of previous similar events and consequences enables the individual to form an opinion of potential for risk based on subjective rather than statistical probability.

'Anchoring' and 'adjustment' combined with 'availability' have key functions in this process. Anchoring, as Nicholls (1999) illustrated, is a process of using prior

significant events as risk benchmarks for similar future events. As such, anchoring provides people with an experience and knowledge base from which future risks can be assessed and predictive preventative adjustments implemented. But because the risk is based on subjective inference and responses, Tversky and Kahneman (1972) contend that predictive adjustment usually fails. Thus Slovic (1987) maintained availability, anchoring and adjustment can lead to an underestimation, or overestimation of a risk.

The outcomes of heuristic judgments not only simplify complex problems or issues to increase certainty but can induce a sense of over confidence. Fischhoff, Slovic and Lichtenstein (1977) warned overconfidence concealed flaws or lack of relevant fact on which judgments were based and revealed the paucity of valid knowledge used to make judgments.

At the same time, studies have shown that heuristic functions can also be valuable cognitive processes. Availability and anchoring allows farmers to use past experience and knowledge to evaluate the potential of an innovation in the initial non-trial stages of adoption (Linder, 1987; Pannell et al., 2006).

Attitudes may be derived from social contexts of values and beliefs which heuristic judgments are supported by or support. As such, Sjoberg (2001) proposed that "attitudes define risk". If this is so then farmer's perceptions of climate change threat may be drawn from their socio-cultural knowledge base and as such be less influenced by 'expert' risk information/knowledge.

The proposition that attitudes derived from personal knowledge/experience can define risk could be of importance to science and extension practitioners in communicating climate change threat to farmers and the broader rural community. Vanclay (2004) and Holloway (1999) observed farming and adoption were inter-reliant processes enmeshed within a socio-cultural context. To consider farming simply as an application of scientific technologies was, Holloway (1999) thought, an overvaluation of technologies' adaptive capacity and undervaluation of socio-cultural influences.

The diffusion/adoption process defines awareness/knowledge as the initial factor in the farmer's decision to adopt (Lindner, 1987; Pannell et al., 2006; Rogers, 2003).

Essentially, research confirms that farmers' values/beliefs and attitudes formed within a farming/rural socio-cultural context are contingent to their perception of risk associated with potential problems and possible solutions (Carruthers and Vanclay, 2012; Guerin and Guerin, 1994).

The implications for science and extension in defining and promoting what are 'right' and 'wrong' options, and determining what is 'good' and 'bad' information to farmers is subject to relationships and social exchanges within farming families and communities. Wardell-Johnson's (2007) research illustrated the aggregation of socio-cultural and economic relationships between rural people and their environments that defined their 'sense of place'. Sense of place, Stedman (2003) concluded, was an intangible, sometimes misunderstood concept, which nevertheless, is a powerful catalyst of the individual's knowledge and identity.

As Holloway (1999) and Vanclay and Enticott (2011) observed, farmers have their own knowledge forms derived from experimental, evaluative, reflective and critical processes, similar to scientific processes. Holloway (1999) cites the challenge for science and extension in communicating scientific climate change information/knowledge to farmers will be avoiding conflict between science's and farmers' knowledge forms.

A contingent element in science effectively transferring climate change information/ knowledge to farmers may be 'trust'. Research suggests that the public's attitudes to climate change and lower sensitivity to the risks could be more influenced by credibility and trust issues with science and policy than the threat of climate change (Garvin, 2001).

2.6 Expert information: Trust, credibility, salience and relevance

Unger (2000) felt the complexity of climate change and the broad range of issues it encompasses challenged the articulation of the impending threat as a single cognitive feature. Etkin and Ho (2007) described climate change as an environmental issue encompassing a conglomeration of threats to virtually all global natural and managed ecosystems. Yet, despite science's communication of climate change, public understanding of the issues and climate change risks has remained limited.

From an American point of view, Garvin (2002) suggested the low perception of climate change threat could be due to the erosion of scientific credence and authority that has occurred in society since the conclusion of the Second World War. Once expected and relied on to provide solutions for problems, science now faces an increasingly questioning and doubting public.

However, Garvin (2001) proposed that the difference in the way the public and scientists conceptualise and assess risk may have been contributing to the issues of trust and credibility. A major difference Garvin (2001) noted was that scientists decreased the complexity by sectionalising the problem and applying the rational of probability within relevant operational sets. On the other hand, the public generally assume or expect an event to either occur or not occur.

Other studies also supported the view that science's credibility with the public was being steadily eroded, but because of other issues including: scientific divisiveness/conflict about climate change (Langford, 2002); concern science was ignoring risks the public thought were important (Margolis, 1996); and out-dated models of risk communication (Botterill and Mazur, 2004). And yet, Etkin and Ho (2007) found there remained an expectation throughout much of Western culture that science would provide solutions to many of the world's problems.

2.6.1 Scientific Divisiveness: Conflicting credibility

Scientific credibility has also been challenged by its own natural investigative approach and the need to debate, review and retest to validate knowledge as legitimate. Langford (2002) found that the public perceived scientific debate and qualified uncertainties about climate change as divisive, conflictive and a sign of weakness.

However, scientific debate about climate change is unavoidable. The evidence almost ensures scientific debate and scepticism is mandatory. Climate variability may be naturally influenced by changes in the elements of earth's orbit, radiative forcing, volcanic activity or natural internal processes of the climate system (EPA, 2012; Robertson et al., 2004).

Most climate scientists almost unerringly attribute the increased rate of global warming to anthropogenic forcing of carbon dioxide and other greenhouse gases

derived from human activities (IPCC, 2001b). However, other scientists and experts have disagreed and maintain that global warming is part of a natural and ongoing climatic cycle (Avery, 2008) or within historically accepted ranges of variability (Loehle, 2007).

Avery (2008) maintains the natural climatic cycle theory is supported by Frakes' (1979) research that pointed to considerable climate variability throughout the geological history of the world. Francis and Frakes' (1993) research proposed the Cretaceous period, long thought to be a period of stable climate, was a time of highly variable climate. In addition, the research indicated global temperatures were possibly much warmer during the Cretaceous period than at present and temperature gradients between the equator and poles had a steeper incline.

The debate concerning increased global temperatures and earlier occurrences of temperature and climate variability extended to the IPCC data concerning historical and recent global warming trends. The claim that the twentieth century was the warmest period for 400 years was disputed with research that indicated warmer temperatures during the medieval period (Dahl-Jensen et al., 1999; Loehle, 2007). In addition, other evidence has demonstrated that global climates cooled between 1940 and 1975, at the same time CO^2 levels were increasing (Singer, 2008).

Further public uncertainty in science may be derived from projections of potential outcomes regarding climate change. It is accepted that models used to project future climate changes are characterised by factors that introduce a level of uncertainty into the calculations; this may increase variability of forecasts (Campbell, 2004). Pittock (2003) points out that scenario projection between each model is different, with impact projections ranging from minimal to severe. Campbell (2004) views this as not unexpected as each model has offset assumptions and constraints.

Another issue which underpins the public's uncertainty and lack of credibility concerning science is when the threat may be a benefit. Research has shown that in some instances increased temperatures and higher levels of atmospheric CO^2 could be beneficial in increasing some plant species' seed yields, including wheat, which may offset effects of some decrease in rainfall (Dijkstra, Hobbie, Reich, and Knops, 2005; McCown et al., 2006; Ludwig et al., 2008).

Even the recorded 20%–30% decline in rainfall in south western regions of WA over the last 50 years (Cramb, 2005) has been found to have had little impact on grain yields and in some cases has produced benefits with reduced water logging and less fertiliser leaching (Ludwig et al., 2008). Science is thus presenting farmers with indicators of climate change risk and also indications of foreseeable benefits arising from changing climates.

Relationships between farmers and science, although not without tensions, have been for the most part collaborative. There have been times when the relationship has been challenged, particularly when farmers' established knowledge forms have conflicted with developing scientific knowledge (Cohen, 2009). An historical example was the conflict generated during the 1840's in America. Liebig's (1842) mechanistic mineral-based theories that led to the use of artificial fertilisers were pitted against Davy's (1840) organic humus-based theories of soil fertility. Davy's theories were compatible with farmers' knowledge and practices at the time, while Liebig's theories challenged the accepted concepts of agriculture. Ultimately, the farmers had issue with Liebig because he was not a farmer, so they did not believe his theory (Brock, 1997).

This historical example of conflict between farmers' knowledge and 'new' scientific knowledge resonates in Holloway's (1999) UK research which illustrated tensions between farmers and science's knowledge forms. This was because the farmers considered scientific knowledge about climate change to be conceived in an environment far removed from theirs and therefore lacked relevance because it failed to address local issues and conditions. In an evaluation and review process the farmers used their own knowledge to select and modify the scientific information/knowledge they deemed applicable.

Relevance and salience, according to Cash et al. (2002), can be key points of difference to diffusion of information and knowledge between science, government and the public. Each of the social structures involved in the information transfer process have their own values of relevance and salience which, if not accommodated, may add to issues of credibility and block the transfer of information. This is perhaps why Vanclay (2004) and Holloway (1999) observed that farmers questioned the authoritative information of science and did not accord

science automatic credibility and legitimacy. The transfer of information from science and government to farmers in this case has been shown to be value-laden (Hunt, Vanclay, Birch, Coutts, Flittner and Williams, 2011; Vanclay and Lawrence, 2007). In essence, science and government is not only seeking to transfer information but also transfer their values to the farmers.

As Wynne (1992) observed, at times this approach may have led farmers to feel science, in following accepted protocols of investigation and pursuing its own agenda, has denigrated and undervalued their knowledge. In addition, Wynne (1992) suggested farmers' perceived fallibility of scientific credibility may have been derived from a belief that science was covering up its own and/or policy makers' past mistakes.

Irrespective of the factors which influence farmers' perceptions of science's credibility, Holloway (1999) and Vanclay (2004) felt science needed to recognise and accept the validity of farmers' knowledge as legitimate to farmers as scientific knowledge. It has also been put forward that the confidence people once had in science has been eroded because the answers science provides are too complex and conditional and/or because scientists keep changing their minds (Hood, Rothstein and Baldwin, 2001). The authoritative role science has assumed in relation to climate change has aligned it to policy makers and governments. This association implies that public perceptions of trust and credibility regarding science are also inextricably linked to trust of governments and politicians (Botterill and Mazur, 2004).

2.6.2 Governments, science and climate governance: A question of trust

Several studies have described the diminishing levels of public trust in government/scientific institutions (Petts and Leach, 2000; Botterill and Mazur, 2004; Garvin, 2001). Public trust in government authority is tenuous and subject to withdrawal if policy is deemed to have been inappropriate or to have failed (Botterill and Mazur, 2004).

In relation to climate change, adaptation studies have shown that governments face further challenges in sustaining public trust and credibility. Governments and industry have been regarded by the public as being both responsible for climate change and not doing enough to address the problem (Lorenzoni, Nicholson-Cole

and Whitmarsh, 2007). Perceptions of distrust have been exacerbated when the public has thought vested interests were influencing policy or doubted government's capacity to deliver solutions (Stoll-Kleemann, O'Riordan and Jaeger, 2001). Decreased trust in governments may also be derived from the public's social perspectives of priority and equitability of an unacceptable economic impact on them as a result of adaptive and mitigation policies (Lorenzoni et al., 2007). Research also indicates public suspicion that governments will use climate change and proposed carbon taxes to increase taxes in other sectors of the economy (Stoll-Kleemann et al., 2001).

Studies further indicate that climate change governance becomes more tenuous as the variability of adaptive needs and options across the social landscape become more diverse. This exposes adaptive policies to conflict as they are applied and made at local, state/regional and national levels (Adger et al., 2008; Corfee-Morlot et al., 2009).

Governance is defined as "The act, process, or power of governing; government" and as "The state of being governed" (*The Free Dictionary by Farlex*, 2012). Stoker (1998) observed the long-established use of the term 'governance' and its dictionary definition had once identified governance as a synonym for government but suggested there had been a change in what governance represents. This change encompassed what Rhodes (1996, page 652) described as:

> *"A change in the meaning of government; referring to a new process of governing; or a changed condition of ordered rule; or the new method by which society is governed".*

Rhodes (1996), in pointing out six separate uses of governance, reiterated the change in definition of governance from its original meaning. The six separate uses of governance cited were:

- The minimal state
- Corporate governance
- New public management
- Good governance
- A socio-cybernetic system

- Self-organising networks

Stoker (1998) proposes the new definitions of governance are more multilayered in defining a governing approach in which distinctions within and between public and private sectors have become less distinguishable. Kooiman and Van Vliet (1993) respond with the idea that an interaction of governing between public and private sectors is derived from a structure which cannot enforce or be enforced. As such, governance has come to mean less of a hierarchal autocratic imposition of rule or regulation by a nation's highest authority and more of a social exchange and negotiation between private and public social structures.

This change in governance has not been without problems as world governments attempt to address issues of global climate change. Some reviewers propose global climate change governance is incapable of ensuring obligatory reductions in greenhouse emissions within set time frames (Barret, 2009; Bernauer and Schaffer, 2010). Meadowcroft (2009) described climate change governance as needing to overcome a state of "institutional inertia", which was restricting development of efficient responses. To address these issues of institutional inertia Corfee-Morlot et al. (2009) advocated a multilevel collaborative governance approach. This approach would reach across all aspects of government from local, regional (state) to national and include other relevant stakeholders to ensure there are no gaps between national policy and plans at local and regional levels. Corfee-Morlot et al. (2009) suggest this approach offers benefits in promoting cross-scale learning between local and regional government departments and other organisations.

However, Adger et al. (2008) suggested adaptive policies and action could be limited by individual and social constraints. Social factors determining adaptive limits emanate from within society and evolve from: what is valued and the applied value; knowledge and information; and perception of threat and cultural aspects. Adger et al. (2008) submit that this coalescence of social factors of values and knowledge can reduce public trust in governments.

The element of public trust in relation to climate change governance is a highly contingent factor in countries with democratic political systems. Bernauer and Koubi (2009) contend that democracies tend to address environmental issues more than non-democratic governments. However, other research has demonstrated voting blocs or voting typologies do not always support increased environmental protection

(Bernauer and Schaffer, 2010; Maibach et al., 2009), although the level of pro-environmental (Green voters) support has the capacity to influence increased environmental protection (Bernauer and Koubi, 2010).

Meadowcroft (2009) advocates government taking a more proactive role in making a difference regarding climate change perceptions. Targeting interest groups and voters can establish "stable societal majorities" who will expect and support maintenance of adaptive and mitigation policy regardless of changes in political leadership. Corfee-Morlot et al. (2009) also advocate a similar approach using inclusive collaborative governance to not only involve all social structures in decision making processes, but to use collaborative governance as an educative process.

Research shows that farmers have conflicting views with policy approaches to climate change. In Mozambique, farmers felt adaptive policy needed to address immediate impacts of drought the instead of preparing contingencies for long term flooding (Patt and Schroter, 2008). Australian farmers were concerned agricultural mitigation policies would substantially increase farm costs and reduce economic viability (Fleming and Vanclay 2009).

Additionally Stehlik, Gray and Lawrence (1999) observed Australian farmers were exhibiting some mistrust of State and Federal Governments that was derived from previous government interventions and assistance when government advice was found to be inadequate or conflicting. This had left a residue of dissatisfaction and general discontent about governments among farmers and their families.

To counter this discontent and distrust, Nelson, Howden and Stafford Smith (2008) proposed a collaborative governance response to drought in Australia's agricultural regions as an alternative to what they call 'Centralised Expert Management'. Centralised Expert Management is described as a hierarchal, autocratic top-down concept that relies on reductionist science to simplify goals to suit chosen methods (Dietz, Ostrom and Stern, 2003). Nelson et al. (2008) proposed an 'Adaptive Governance' concept similar to what Corfee-Morlot et al. (2009) proposed in place of 'Centralised Expert Management'. The objective was to develop a sense of shared ownership and accountability in drought assistance management through local

participation. The idea was for communities and governments to collaboratively develop governance systems that allowed drought affected farmers to self-select access to assistance based on standards of farm and environmental management set by local communities and governments.

For the 'Adaptive Governance' approach to be effective in addressing climate risk, Nelson et al. (2009) identified the role of science as integral in distributing contextually relevant support and incorporation of local knowledge in decision making processes, in addition to informing rural communities and policy makers of critical livelihood impacts.

The challenge for science and policy in communicating climate change information lies not only with public perceptions of science and government credibility, but with science and government developing an understanding of the diversity of social structures and needs and issues within society. It is important to avoid the potential for individuals and social structures such as farmers to perceive and experience social alienation under adaptive and mitigation policies. The perceived inadequacies of government could also be compounded within farming communities by perceptions that the broader Australian community did not care or understand what they were experiencing as shown by Alston and Kent, (2004).

As stated earlier, inclusive facilitation is one approach advocated for government to alleviate the potential for alienation of social structures through adaptive and mitigation policies (Dengate et al., 2006; Nelson et al., 2008). Dengate et al. (2006) identified that the value of the process for government and the public was in its inclusiveness of all stakeholders in addressing public/policy issues, rather than government implementing policy and then attempting to use the group approach to justify its actions.

When considering relationships between recipients of climate change knowledge and those who generate the knowledge, it is important to examine how the information is transferred into the public domain. The next section reviews the processes of government and its agencies of communication of climate change and popular media's involvement in the process.

2.7 Communication, information and knowledge transfer

Most scientific and policy related climate change information is conveyed to the public via print and electronic media. As a consequence, Anable et al.'s (2006) review found that increased media coverage of climate change had expanded availability of information and placed climate change at the forefront of the public consciousness. Added to this is the effort made by government and sciences to transfer knowledge to industries such as agriculture using extension. One of the primary aims of Australia's National Agriculture and Climate Change Action Plan (NACCAP) 2006–2009 (Natural Resource Ministerial Council (NRMC), 2006) was to transfer scientific information/knowledge to farmers to facilitate the incorporation of such knowledge into farm decision-making processes. Agricultural extension networks were central to this information/knowledge transfer approach and have been used in its implementation. This section reviews the roles that media and extension have in communicating climate change.

2.7.1 The media's role in communicating climate change

Although the media's intent is to provide balanced reporting of climate change issues to the public, it has at times undermined the integrity of the information and/or its sources. There is some contention that the media conveys perceptions of divisiveness within science and tensions between interests of policy, science and the public (Brossard, Shanahan and McComas, 2004). Alternately, Meyer (2006) proposes that journalists generally accept scientific knowledge and expert conclusions should be reported without investigation or query.

Studies show that generally the American public trust and value their media as a source of unbiased information (Fortner et al., 2000). Yet in Maibach et al.'s (2009) research, only 47% of respondents trusted American mainstream news media as a source of global warming information, while 33% were 'somewhat distrustful' and 20% 'strongly distrustful'. Krosnick, Holbrook and Visser (2000) concluded that American media's coverage of climate change did little in increasing knowledge among educated people and Potter and Oster (2008) questioned how climate change, as a matter of public concern, could be ever fully represented in the mass media.

According to Trumbo (1996), reporting of climate change in American newspapers over the last twenty years has tended to wax and wane. Initial reporting in the late 1980's was very limited and reflected a low importance attributed to climate change. After this, climate change coverage steadily increased, reaching a peak during the Rio Earth Summit in 1992 when it was recognised as a serious problem. Following this period, Trumbo (1996) believed reporting of climate change decreased, due in part to editorial fatigue and a lack of demonstrable impacts.

A UK assessment of newspaper reporting of climate change from 1985 to 2005 found media coverage had increased as impacts of climate change, particularly extreme weather events, were shown to be affecting ordinary people in local communities (Carvalho and Burgess, 2005). Assessments of climate change coverage in the UK and America from 2003 to 2006 also show that newspaper coverage in America increased but with more focus on the politicisation and economic implications of climate change (Boykoff, 2007). During this period, newspapers began to emphasise climate impacts attributable to human activities and focussed less on catastrophes perceived to be natural occurrences (Smith and Joffe, 2009).

Studies in America have shown that the media has also been used to promote the voices of scepticism (Antilla, 2005). Prominent media coverage was given to a group of dissenting scientists supported by organisations profiting from the use of fossil fuels who were undermining climate change science (Antilla, 2005; U.S. Public Interest Research Groups, 2004). Given that most Americans draw information about science and related issues from the media, the views of the dissenting scientists, who were not subject to peer review, had a broad audience. Antilla (2005) concluded it was important to recognise the media's role as not only reporting climate change but in constructing the social of context climate change.

In normal circumstances Potter and Oster (2008) held that fundamentally the media transferred information in a progression from source to recipient via reporting of facts and issues. However, Potter and Oster (2008) stress that climate change obviates this process as it is not the fact or issue within a narrative but the story itself. Unger (2000) describes climate change as a broadly diffused future orientated topic representing multiples of issues that challenge the media to articulate the threat

as a single cognitive feature. As a result, Unger (2000) believed transference of climate change information by the media had become a process of sensationalist popularised information bytes portraying issues in isolation and lacking the capacity to communicate relevant scientific knowledge. Unger (2000) proposed such a process had led to greater public ignorance despite the exponential expansion in information.

While there is debate over the effectiveness of the media in increasing climate change knowledge, reporting of climate change has increased the volume of information available to the public. However, the Australian government and scientific institutions have indicated awareness that transference of information does not guarantee increased knowledge, particularly in agriculture. One strategy outlined in the government's NACCAP 2006–2009 (NRMC, 2006) aimed to improve climate change information/knowledge transfer between science and farmers. Literature concerning transference of climate change information/knowledge between government and scientific agencies to farmers is examined in the ensuing section (2.7.2).

2.7.2 Science and agricultural extension: Knowledge transfer to farmers

The objective of the NACCAP (NRMC, 2006) was to promote strategies to manage multiple climate change threats to agricultural sustainability. The strategies included adaptation options to build resilience into agricultural systems and mitigation responses to reduce agricultural greenhouse emissions. Research and development would underpin the adaptation and mitigation strategies and be supported by extension processes to increase awareness and inform decision making by primary producers and rural communities.

The communication of information transfer element of the plan (NACCAP, NRMC, 2006) was identified as critical to the overall process. Understanding of climate change issues for stakeholders in agriculture was initially assessed and barriers to communication identified. Ultimately, successful implementation of the strategy was reliant on farmers and other agri-industry stakeholders recognising the need to respond to climate change. Yet, in 2006 Stenekes (2009) found there was very little information available to indicate if projections of climate change impacts on

agriculture were influencing farmers' perceptions of potential threat. As illustrated by research, motivation is a contingent element in engaging the adoptive response processes (Pannell et al., 2003; Rogers, 2003).

The MDB study found participants sought information from a variety of sources including science, government and industry/grower group structures as well as national, state and regional print and electronic media networks (Milne et al., 2008). Some participants thought the information was contradictory, while others reported feeling overwhelmed or confused**.** Responses of residents and farmers in WA's Northern Agricultural Region were similar where 65% of respondents believed climate change was human-induced but 68% felt conflicting information contributed to their general uncertainty about climate change issues (Howard, 2008).

Although these studies indicated issues with communication and information transfer, there have been projects that have effectively incorporated scientific climate change knowledge into farm decision-making processes and planning (Noonan et al., 2012; Souness, 2009; Storer, Noonan, Heath and Murray-Prior, 2011). In WA the "Farm Business Resilience" (FBR) pilot, undertaken under the auspices of the Federal Government's drought pilot, incorporated grounded research of group-facilitated iterative adult action learning approaches (Adams, 2010; O'Neil and Lamm, 2000) in communicating and integrating climate risk into farm business strategic planning (Storer et al., 2011). Early evaluation indicated significant changes in farmers' attitudes to climate change and climate risk management (Storer et al., 2011; Noonan et al., 2012).

The Victorian Department of Primary Industry (DPI) "Practice Change" strategy also incorporated facilitated group interactive learning and focused on up-scaling farmers' meteorological knowledge (Souness, 2009). The aim of the program was achieved with some success in improving farmers' decision making and planning by increasing understanding of broader climatic forces and drivers of local weather (Anderson, 2010).

Ultimately, as Dengate et al. (2006) maintain, attitudes and behaviours only begin to change when the distance between implicit and explicit values/beliefs converge. This can only begin when information/knowledge is contextually relevant and is

inclusively incorporated as the WA and Victorian experiences have demonstrated. The inclusive group facilitated action learning approach offers science the medium to transfer knowledge to farmers' socio-cultural environment using people who understand and connect with the farmers (Carruthers and Vanclay, 2007; Cohen, 2009). Evaluation of the FBR pilot in WA suggests science, in taking this path, is able to address two socio-cultural rudiments of agriculture. That is: each farm is acknowledged as unique and farmers become part of the discourse rather than passive recipients of a hierarchal dissemination of knowledge (Noonan et al., 2012; Souness, 2009; Storer et al., 2011).

2.8 Summary and discussion

Climate change is a phenomenon mired in issues of complexity and uncertainty for scientists, policy makers and the public. There are three certainties of climate change: mean average global temperatures have increased over the last 100 years, mean average temperatures have increased at a rapid rate over the last 100 years, and effects of global warming and changing climates are observable and measurable (IPCC First Assessment Report, 1990; IPCC Second Assessment Report, 1995; IPCC Third Assessment Report, 2001; IPCC Fourth Assessment Report, 2007).

However, these certainties are themselves sources of complexity and uncertainty. The cause and effect of global warming is debated within the scientific community. Future changes in global climates and outcomes of the changes are uncertain. Science is only able to project outcomes that may or may not occur and offer solutions that may or may not deflect the worst of the projected impacts.

Even though climate change is an acknowledged, measured scientific certainty, the threat it poses for the global community in the future retains an intangible ambiguity. It could be this ambiguous intangibility that most influences attitudes to the threat of climate change.

Research has identified that the general public, while mostly aware about climate, were less concerned and were not prioritising it as either an issue for policy or personal response (Bord et al., 1998; EORG, 2002; Lorenzoni and Pidgeon, 2006; Maibach et al., 2009; OST/MORI, 2004). Socio-cultural influences concerning construction and perception of risk were shown to be contributing to perceptions of

climate change and climate change threat (Covello and Johnson, 1987; Maibach et al., 2009). Social profiling of Americans has illustrated relationships between socio-cultural characteristics and intrinsically held beliefs and values regarding peoples' attitudes to climate change (Maibach et al., 2009).

In addition, research has indicated issues with information/knowledge transfer between 'experts' and the public (Anable et al., 2006; Botterill and Mazur, 2004; Etkin and Ho, 2007; Langford, 2002; Leiserowitz, 2006). Studies suggest that these issues were derived from science's waning trust and credibility with the public (Botterill and Mazur, 2004; Garvin, 2001; Hood et al., 2001; Langford, 2002; Petts and Leach, 2000) and associated with public trust in governments and concerns governments were not addressing issues the public considered important (Garvin, 2001; Lorenzoni et al., 2007; Stoll-Kleemann et al., 2001).

The tensions between government, science and the public were identified as challenges and encumbrances for climate change governance (Barret, 2009; Bernauer and Schaffer, 2010; Meadowcroft, 2009). Alternative approaches proposed to address these governance issues focused on consideration of devolution of policy development and collaboration between all levels of government, science and other public and private stakeholders (Corfee-Morlot et al., 2009; Nelson et al., 2008).

Farming communities' attitudes to climate change were also shown to be complex. Farmers in Nepal, Africa, Australia and the UK had noticed changes in climate and effects of the changes (Dahal, 2006; Gbetibouo, 2008; Holloway and Ilbery, 1996; Patt and Schroter, 2008; Pink, 2008). However, while many of the farmers were uncertain if the changes were permanent climate changes they were confident they would be able to adapt (Gbetibouo, 2008; Holloway, 1999; Milne et al., 2008).

Tension between farmers and 'expert' knowledge was also illustrated, with farmers more likely to rely on their own experience than experts in evaluating climate threat and risk (Dahal, 2006; Holloway, 1999). In some studies, climate change was viewed by farmers as somewhat beneficial or as an opportunity (Gbetibouo, 2008; Holloway and Ilbery, 1996; Pink, 2008). Farmers also had issues of trust with government and were concerned with aspects of governance equity and priorities and potential for

climate change policy to adversely affect their businesses (Fleming and Vanclay, 2009; Patt and Schroter, 2008; Stehlik et al., 1999).

In several studies, issues with communication and information transfer were identified as underpinning the uncertainty about climate change. Information was perceived by people to either be lacking, contradictory, irrelevant and/or not salient (Anable et al., 2006; EORG, 2002; Holloway, 1999; Howard, 2008; Milne et al., 2008). Government/scientific institutions risk/threat communication approaches were evaluated as becoming increasingly ineffective (Botterill and Mazur, 2004). However, new iterative group-facilitated approaches to Australian agriculture appeared to be delivering some positive outcomes in science climate change knowledge transfer and integration into farm decision-making and planning (Anderson, 2010; Noonan et al., 2012; Souness, 2009; Storer et al., 2011).

Additionally, public uncertainty about climate change was seen to be linked to the media's approach to reporting climate change. On one hand the media was contributing to public perceptions of science's divisiveness about climate change and tensions between science and policy (Brossard et al., 2004). Alternately it was suggested the media was challenged in articulating the complexities of climate change as a public cause for concern (Potter and Oster, 2008). Ultimately, Krosnick et al., (2000) concluded that the media did not increase public understanding and knowledge of climate change. However, there appeared to remain an incomplete understanding within the research as to what information/knowledge networks were viewed as important or useful by various socio-cultural structures within the broader framework of society.

The farming and general public's attitudes to climate change are to a large extent an aggregation of personal and socio-cultural values and long-held beliefs. Adger et al. (2008) contend climate change governance encompassing adaptive and mitigation responses could be limited by these individual and social constraints. In regard to farmers, this entails understanding that their evaluations of climate change are undertaken within a socio-cultural context of ingrained values and beliefs. The rational of their conclusions is the relevance which exists between their values and beliefs, and what is needed to be done. As noted by Holloway (1999) and Vanclay (2004), the challenge for science and extension is to recognise farmers' knowledge

as valid and to introduce scientific knowledge without denigrating farmers' knowledge.

Long term climate change adaptation by farmers is dependent on their attitudes to climate change and the perception of risk that they discern from their beliefs in relation to climate change. The need for more research is illustrated in a lack of information identifying definitive climate change attitudes within farming communities. Social profiling of farmers, agribusiness representatives and non-farming rural residents may provide some understanding of relationships between farming/rural socio-cultural values and attitudes to climate change.

Chapter 3: Research Methodology

3.1 Chapter Outline

This chapter describes and justifies the methodology in Section 3.3 that was used to generate the data for the qualitative and quantitative stages of the research. The chapter begins with a discussion of the qualitative methodology and research process (Section 3.4). The quantitative methodology, research design (Section 3.5) including the research assumptions and the parameters of the research are then described. The construction of the survey instrument and the method used for data collection (Section 3.5.1) are then discussed. This is followed by an examination of the research delimitations and assumptions (Section 3.5.2) and practical aspects of the research, as well as a description of the survey questionnaire design (Section 3.5.3). Values and labelling of scales on the questionnaire are described in Section 3.5.4. Pre-testing of the survey (Section 3.5.5) and adjustments made to the survey as a result of pre-testing are discussed in Section 3.5.6. Delivery of the survey is explained in Section 3.6 with descriptions of methods of data entry (Section 3.7) and statistical analysis (Section 3.8) following. The chapter concludes with a summary and discussion in Section 3.9.

3.2 Introduction

During my final years as a practicing farmer, climate change had started to encroach into the dialogue relating to the future of agriculture. At the time, around 2003–2004, it seemed to me as a farmer in the Great Southern region of WA that there were far more pressing issues to contend with. Climate change was an indeterminate problem which rated as very low priority of concern. Rising input costs such as fertiliser and chemicals, along with volatility in markets which often resulted in lower prices than anticipated, were the primary concerns. Coming from this background, I was sensitive to the influence my experience could have on structuring the questions and the outcomes of the survey.

I was mindful that my experience as a farmer presented both advantages and disadvantages. On one hand, I had retained contact with people in the rural sector, so I was aware of some of the opinions being expressed about climate and climate

change, along with other concerns. This knowledge provided an insight which enabled me to broadly frame questions that addressed the views being expressed in a manner which was sensitive to the intended research population. This sensitivity extended to the language used in questions/statements, with much effort made to ensure language was farmer/rural-centric.

At the same time, research had indicated that my experience could also be a disadvantage in that I could lead participants via questioning to reflect what I considered to be important issues (Dalton, Elias and Wandersman, 2001). Therefore it was important I exercised caution while at the same time maintaining an open mind in my approach to the research.

The primary intention for this research was to ensure no key constructs were excluded and all relevant issues were addressed. To ensure integrity of the research and construction of the survey instrument I decided to use a discovery process advocated by Kleining and Witt (2001) which allowed participants' ideas and opinions to emerge. This method ensured that the research would be directed by participants' perceptions and points of view and not by my assumptions. Research suggested a multi-method approach was the most suitable method for this research as it allowed for an integration of qualitative and quantitative data (Weinreich, 1996).

3.3 Methodology

Farming, farmers and the broader rural community mirror a multifaceted collection of socio-cultural beliefs, values, ideas and attitudes. The potential regionalised effects of climate change represent a vastly complex problem which scientists predict will induce societal change. In trying to understand rural Western Australians' attitudes to climate change, science and governance, and the influences of these attitudes, this research used a multi method qualitative/quantitative approach of discovery advocated by Kleining and Witt (2001).

The research was largely explorative in nature in seeking to discover and understand rural peoples' attitudes to climate change within the complexity of broad view climate change and the relationships and social power dynamics between rural micro and meso social structures and the macro social structures of science and government. To facilitate the process of understanding, a heuristic methodology

structured on a process of discovery derived from Wardell-Johnson's research (2005) was applied.

Application of the methodology was designed to identify as much of the range in attitudes, perceptions and characteristics as possible. This was done to develop measures of statistical associations and differences of extrinsic characteristics and intrinsic values that contributed to rural participants which had been demonstrated in earlier research (including farmers, rural business people and non-farmers who live and work in rural communities) (Belbin, Faith and Minchin, 1984; Wardell-Johnson, 2007). Development of statistical associations of characteristics and values between and within groups of rural people had been identified as an effective approach to identifying ranges or scales of typological attributes of farming communities in other countries (Köbrih, Rehman, and Khan, 2003; Selter, Hartebrodt, Brandl and Herbohn, 2009) and in Australia (Emtage and Herbohn, 2011; Kuehne, Bjornlund, and Cheers, 2007; Wardell-Johnson, 2007). Other research had shown that in exploring factors which contributed to typological characteristics of attitudes it was necessary for the researcher to remain open to changing concepts and avoid a rigid adherence to prior assumptions about the topic (Gough and Price, 2004).

A post-structural heuristic approach was applied in undertaking this explorative examination of participants' attitudes to climate change. A post-structural heuristic approach requires four key criteria described as the 'Hamburg rules of explorative research' to be met by the researcher (Kleining et al., 2001). The rules are defined as:

- Openness of the research person
- Openness of the research topic
- Maximum variation of perspectives
- Discovering similarities and integrating all data

The heuristic post-structural approach recognises that intrinsic attitudes and values are formed through an evaluative, iterative process influenced and conceptualised within personal, socio-cultural and bio physical contexts as illustrated in other studies (Wardell-Johnson, 2007; Gough and Price, 2004). The approach is aimed at discovery through collective exploration which is re-examined through repetitive investigation for similarities that by their distinction define differences (Wardell-

Johnson, 2007). The criteria to meet the post-structural approach as described by Kendall and Wickham (1999) and Wardell-Johnson (2007) are to:

- Discover diversity through relationships
- Avoid overarching claims/grand narratives
- Avoid second order judgments
- Expect dynamic systems
- Expect non-linear relationships
- Humans are agents
- History plays a part

The iterative process of the approach in precluding or limiting the use of prior assumptions facilitated the emergence of results and issues from the research. This was assisted by the iterative heuristics applied through the mixed-method approach.

Studies indicated 'Purposive' sampling during the semi-structured interviews would achieve representativeness of rural Western Australians within the small sample selected (Tashakkori and Teddlie, 2003a) with the focus being on depth of information provided (Teddlie and Yu, 2007).

Purposive sampling was also chosen for the quantitative stage of the research as studies had shown it was compatible with the mixed method approach and an effective way to study a specific socio-cultural domain (Tongco, 2007; Zhen, Zoebisch, Chen and Feng, 2006). The focus of the research during this stage was establishing the range of information provided by a cross section of representative rural and farming participants.

The combining of qualitative/quantitative methods had been shown to allow the opportunity to produce two complementary databases which offered representativeness and generalisability along with a depth and range of information across the study (Teddlie and Yu, 2007).

Combining qualitative and quantitative methods sought to introduce more rigor to optimise qualitative and quantitative approaches and results in this research. This approach was a deliberate response to the earlier studies of Australian farming

communities' responses to climate change. These studies had addressed either representativeness or depth through qualitative approaches (DAFWA, 2006; Milne et al., 2008) or scope and generalisability in quantitative approaches (Pink, 2008). For example the information generated from both the DAFWA (2006) and Milne et al.'s (2008) qualitative studies had depth and was rich. However, representativeness and generalisations were limited due to the small samples of 54 participants in the DAFWA (2006) study, and 86 in Milne et al.'s (2008) study.

Alternately, the ABS (Pink, 2008) quantitative survey of farm management and climate included a breadth of information and was representative with large sample sets drawn from farming populations across Australia, but had limited depth due to the low qualitative information input. Application of an integrated, heuristic multi-method approach draws representativeness, depth, scope and generalisability together in the research and moves beyond triangulation by utilising the optimal elements of qualitative and quantitative approaches.

The value of a mixed method approach was further underlined during the iterative process as complex and diverse relationships emerged concerning rural peoples' knowledge forms about climate derived from an historical base and adjusted within their socio-cultural context. As Chawla (1998) observed, the approach enabled extended examination of emotional and interpretive aspects of participants' experiences with climate. Other research suggested this could reveal implicit environmental values and beliefs that could influence attitudes and determine motivation or intention to take action (Hungerford and Volk, 1990). However, as Wardell-Johnson (2005) proposed, examination of peoples' characteristics within complex systems required an assumption of non-linear relationships, variance and unanticipated associations.

The intention of the qualitative study was to allow participants' ideas and opinions about climate change to emerge. It was these ideas and opinions that would provide a conceptual background of rural peoples' attitudes to climate change. However, it was important prior to undertaking the research to have a clear theoretical understanding of what attitudes were and how attitudes developed.

3.3.1 Attitudes: Sources and influences

To examine rural peoples' attitudes to climate change, it was important to understand how attitudes developed, what influenced attitudes and why attitudes could predispose people to specific outlooks and behaviours. Attitude is defined as "a position, disposition or manner with regard to a person or thing" (*The Macquarie Encyclopedic Dictionary*, 1995). However, Eagly and Chaiken (2007, page 582) expanded on this basic definition, defining attitudes as:

> *"…a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor".*

In earlier work, Eagly and Chaiken (1993) proposed the definition of attitudes as encompassing three fundamental features: evaluation; attitude object and tendency.

Attitude theorists posited that attitudes are formed via an evaluative meditative process (Fishbein and Ajzen, 1975) described as a cognitive learning perspective (Taylor-Gooby and Zinn, 2006) within accepted value concepts of associated social structures (Greenwald, Rudman, Nosek, Banaji, Farnham and Mellot, 2002). Eagly and Chaiken (1993) suggested evaluation included all types of evaluative responses regardless of whether a response was cognitive, affective, behavioural, overt or covert. Nor was it necessary that these reactions be consciously experienced.

Attitudes, it was suggested, could be fundamentally construed as aggregations of stabilised and acquired beliefs and values derived within social-cultural contexts (Taylor-Gooby et al., 2006). Others propose that stabilised attitudes formed in early childhood and shaped by family values are usually maintained throughout life Stern and Dietz (1994). Greenwald et al. (2002) suggest that new attitudes developed from new beliefs and values later in life tend to be comparable to the stabilised attitudes formed during childhood.

Other research has shown that attitudes are developed and articulated within the context of place and in association with other people and contribute to an individual's sense of identity (Bullock and Trombley, 2000; Wardell-Johnson, 2007). Bullock and Trombley (2000) suggest that identity can be understood as a form of self-image derived from an individual's comparatively constant set of

personal characteristics. The elements which contribute to an individual's sense of identity are derived from the interaction of the relatively constant psychological constructs and relativity with social identity. Bullock and Trombley (2000) and Wardell-Johnson (2007) assert a dynamic interaction between these elements exists with other socio-cultural environments and places that may lead to changes in attitudes over time.

Malpas (1999) observed that self-identity develops subjectively in relation to other individuals and groups of people from a multifaceted series of attitudes and actions related to the context of certain environments, socio-cultural practices and a relatively constant psychological construct. According to Malpas, the three separate concepts of interdependence of objectivity and subjectivity are: 1) self-subjectivity; 2) objectivity and 3) other-subjectivity. The relationship between the conceptual pairs of subject and object, along with inter-subjective coupling of self and 'the other' reflects the concept of self and 'the other'.

3.4 Familiarisation research process

The methodology necessitated a range of data collection methods and the use of questioning designed to explore the processes in use during the development of attitudes. Whiteley and Whiteley's (2006) 'Familiarisation Study' method was chosen for the qualitative explorative stage of the research. Familiarisation study methodology is purely explorative and heuristic in approach, with the aim of allowing theories to emerge from a small relevant sample set. This fulfills two functions. Firstly, it allows the researcher to index the categories and allows the findings to direct the study. Secondly, it reduces the influence of the researcher's own theories and prior assumptions of the topic.

Whiteley and Whiteley (2006) maintained the Familiarisation study was an independent methodology which shared some characteristics with the pilot study methodology. The main difference between the two methodologies was in the basic grounding of design choices at the start of a study. The pilot study is used to pre-test materials that have emerged from earlier exploratory research (Weinreich, 1996) and test what is been planned for the field work (Mason, 2002). The Familiarisation study is the starting point in information generation and the iterative process.

The approach offered by the Familiarisation study provided what Peeler (2005) considered as an opportunity for participants to put forward ideas, suppositions and/or assumptions they had developed within local socio-cultural and bio-physical contexts. This could rule out Kleining et al.'s (2001) concerns of any preconceptions on the researcher's behalf. Weinreich (1996) maintained this then allowed ideas, assumptions and suppositions that were brought forward by the participants to be tested, measured and compared to the quantitative data.

This leads to one of the key concepts of Familiarisation methodology which Whiteley and Whiteley (2006) described as an informal element of the researcher's familiarity with participants' backgrounds. This informal element facilitates a level of trust between the researcher and participants which can be helpful in precluding participants' concerns with being judged by the researcher. Hill (2007) proposed this alleviated participants' concerns of being judged, which Peeler (2005) thought important in developing reciprocity of trust between participant and researcher, which contributed to building relationships of rapport and respect.

The Familiarisation research was undertaken using a semi-structured in-depth interview instrument with a small sample set of farmers, agribusiness and rural community representatives. The intention was that in-depth interviews applied to a smaller sample set would produce more detailed and specific data.

Interview participants were selected from a sample set provided by farming and agriculture industry representatives. Some participants were personally known to me, but were not close acquaintances. This allowed the establishment of some common ground between me as the interviewer and the participants without compromising my impartiality. While the participants knew that I had been a farmer, they were not familiar with my personal circumstances or views. Presenting as a researcher that had been a farmer encouraged the participants to focus on my primary role as an interviewer with understanding of their circumstances. This approach promoted a level of affinity and trust previously described by Gee (2000) which Whiteley and Whiteley (2006) defined as crucial in the Familiarisation study.

However, in examining participants' views on climate change, Dalton et al. (2001) maintained that care needed to be taken in framing the questions. Simply asking if

climate change was occurring had the potential to compromise or stifle participants' reflections on the topic. Asking the question in this form could suggest that a concise response of acceptance or non-acceptance was required. If the question was perceived as such, then Dalton et al. (2001) suggested responses would tend to be polarised and lack depth of reflection and evaluation. Mantzoukas (2007) asserted that asking participants what they thought about the topic in question allowed them to freely express their views and ideas across a much broader spectrum of the topic. In turn, my role as interviewer became what Hill (2007) described as a proactive listener rather than an intervening questioner.

Those approached to take part in semi structured in-depth interviews were drawn from a variety of the businesses representative of Western Australia's agricultural sector. An effort was made to include representation of the agri-finance, agri-insurance and agribusinesses involved with domestic and export interests as well as farmers. Farming participants were drawn from the northern and southern agricultural regions of the state.

Potential participants were contacted initially to see if they would be interested in taking part in an interview. If they agreed to be interviewed, an appointment was made to conduct the interview by either phone or personal contact at a time and place convenient for them. Sixteen people were initially approached with seven agreeing to be interviewed.

Most of those who declined to be interviewed did so because of other commitments. Two people who declined to be interviewed were employed in the agri-finance and insurance industry. Both were concerned there may have been some business confidentiality issues associated with taking part in the research.

Prior to conducting the semi-structured interviews, an opportunity to interview two Aboriginal participants arose. The two individuals were members of an Aboriginal community which was operating a farming business. As members of the community, both individuals were involved in the management and daily operations of the farm.

Initially I was reticent to include them in the interview process because I knew both very well. I felt the familiarity between us had the potential to overshadow my role

as the interviewer/researcher. Alternately, having spent much of my life with Noongar people, I understood the importance of trust that many Aboriginal people needed to feel before they were prepared to speak freely with non-Aboriginal people. Ultimately, interviewing the Aboriginal participants offered an opportunity to explore the perceptions of climate change of people whose traditional indigenous cultural structures were described by Harben (2008) as intimately embedded in the natural environment and whose culture defined their relationship with the land as *"ngalak ngaank nitja budjar"* (This land, our mother).

3.4.1 Familiarisation Study: Qualitative question structure and interview procedure

The primary questions for the in-depth interviews were derived from a review of the literature and addressed participants' perceptions about climate change. Although international (Anable et al., 2006; Dunlop and Saad, 2001) and Australian studies (Buckley, 2000 DAFWA, 2006; Milne et al., 2008) had found a majority of people were aware of climate change and many were apprehensive or concerned about climate change, climate change was not perceived as a priority issue. This situation had not altered after this research commenced (Adger et al., 2008; Berry et al., 2011; Evans, Storer and Wardell-Johnson, 2011; Fleming and Vanclay, 2009). The studies indicated limited or poor understanding through incomplete knowledge or misconceptions contributed to people's subdued concern.

The MDB case studies conducted by Milne et al. (2008) showed there was not a collective acceptance of climate change in the region. Only 36% of participants accepted climate change was occurring, and 24% thought it might be occurring but were not sure. Of those who agreed climate change was occurring or might be occurring, just 20% thought it was caused by human activity. Another 10% believed it was a natural climatic cycle which some expected would return to "normal". A further 10% of the participants were uncertain as to the causes of climate change and 60% did not respond to the question.

The results of Milne et al.'s (2008) research indicated that the question was not simply about climate change happening or not. Rather, the results demonstrated there were three other forms of acceptance/belief about climate change occurring, being:

1) Climate change was a natural phenomenon

2) Climate change, although occurring, would not affect respondents' local areas

3) Human activity was contributing to climate change

It therefore became a key imperative of this research for the in-depth interviews to be used to investigate if perceptions of WA's rural people were similar.

3.4.2 Familiarisation Study: Questions and interview format

Although it was important to fully explore the extent of participants' views about climate change, the literature indicated that peoples' opinions could be influenced by a variety of factors. These factors included: observed changes in the climate (DAFWA, 2006; Fleming and Vanclay, 2009; Milne et al., 2008; Pink, 2008); what participants thought was contributing to changing climates (Fleming and Vanclay, 2009; Milne et al., 2008,); and what participants thought of science's warnings about climate change threat (Langford, 2002; Garvin, 2001).

It was therefore decided that the in-depth question format would maintain a fundamental approach in covering what appeared to be the four key criteria associated with climate change. These criteria were:

- attitudes to climate change
- observations/experience of local climate
- what was contributing to climate change
- perceptions of science's assessment of climate change risk/threat

The number of questions and the questions asked during interviews were dictated by participants' responses to initial questions of what they thought about climate change. On occasions, in the process of responding to the initial question some participants also provided information relevant to other questions or generated additional questions from responses. During four interviews, participants were asked a total of nineteen questions including prompts or qualifying questions. Between thirteen and fifteen questions were used for the remaining three interviews. (A copy of these interviews is presented in Appendix 3).

The following questions were asked during interviews:

- What do you think about climate change?
- Have you noticed any changes in the climate?
- What do you think could be causing the climate to change?
- What do you think about scientists' warnings that climate change could be a serious threat to agriculture in the future?
- What are your perceptions of the role science has in responding to climate change?
- What are your perceptions of science's credibility concerning climate change?
- What are your perceptions regarding the trustworthiness and credibility of government regarding future policy responses to climate change?

To allow the interviews to function as an information generation process, a more informal, semi-structured approach was used as proposed by Whiteley and Whiteley (2006). Each interview commenced with the question, "What do you think about climate change?" The intention was to give the participant as much scope as they needed to express whatever opinions, perceptions or ideas they had about climate change. If participants chose to respond by giving an account of what they thought, they were allowed to continue the narrative.

Polkinghorne (1988) contends that narratives can be important in the qualitative research process due to the depth of meaning narratives can add to responses. In essence, the narrative develops additional meaning in allowing participants to consider a single specific issue or variable as a component within a much broader context, which can influence or lead to other issues or outcomes in the broader picture. As such, the narrative gives coherence, meaning and logic by enabling participants to provide the interdependent linkages which draw together diverse occurrences, events and activities within the human state.

As a result, the time taken to complete interviews varied widely with some interviews completed within fifteen to twenty minutes and other interviews running for forty five to sixty minutes. A number of participants addressed questions in a very succinct fashion, whereas other participants expressed their responses as a

series of short narratives. This was the case particularly for the indigenous participants whose traditional culture uses story narratives as a medium for transferring knowledge (Harben, 2008).

3.4.3 Familiarisation Study: Ethics approval and data collection

In preparation for commencement of the research field work stage, ethics approval was applied for and granted by the Curtin University Human Ethics Committee. Face-to-face interviews were conducted with six participants with the other three participants interviewed on the phone. Four of the face-to-face interviews took place at the participants' places of work or their homes. The other two interviews were conducted in the researcher's office.

Interviews took between fifteen and sixty minutes to complete. Interviews were recorded in note form and in some cases during face-to-face interviews contacts were taped. The interviews were then written up at a later date. Only responses relevant to the research were recorded. All of the interviews were conducted by me as the principal researcher.

A number of strategies were used if participants' responses or accounts tended to move off subject or focus on issues unrelated to the research but were considered important and/or relevant by the participant. If a participant was providing non-relevant information, Kvale's (1996) strategy of using structuring questions to refocus the participant on the line of questioning was used. If it was thought intervention could compromise the affinity/trust relationship between interviewer and interviewee, the participant was allowed to continue uninterrupted until an appropriate moment and then redirected back on subject by either using structuring or direct questioning methods as suggested by Kvale (1996).

However, during the interviews with the two Aboriginal participants, allowances were made in the process for the participants to complete each other's responses. This was because the Aboriginal participants were accustomed to responding in such a manner and during the process incorporated relevant information alongside unrelated issues. Intervention or attempts to redirect the interview to only specific topics could have offended or embarrassed the Aboriginal participants and may have resulted in a premature termination of the interview.

In interviewing the Aboriginal participants there was also a deviation from the one-to-one interview procedure which had been used for interviews with non-Aboriginal participants. The Aboriginal participants were, at their request, interviewed together as they felt more comfortable being interviewed together than individually.

3.4.4 Familiarisation study: Interview Analysis

Analysis of the interviews entailed an intuitive approach. Key points, principle issues and elements were drawn from each interview and allocated to one of six general areas of interest in the research being:

1) Opinions/views/thoughts about climate change

2) Observations/experience of changes in the climate

3) Causes/influences of climate change

4) Science's role and credibility in climate change both as a generator and diffuser of information

5) Perceptions of trust and credibility in government responses to climate

6) Climate change information/knowledge systems.

Additional information regarding socio-cultural knowledge/information systems was derived from participants' comments when validating their opinions or views on a particular subject or answering a question.

3.4.5 Description of participants

The sample set comprised: four farmers, an agronomist, an agri-banking representative and a livestock agent in addition to the two Aboriginal community members who were involved in managing an Aboriginal Community Farm in the Great Southern Agricultural Region. The farmers and the Aboriginal community members were drawn from four agricultural regions that were to be represented in the follow-up quantitative survey. The agronomist, livestock agent and agri-finance officer all had more than twenty years' experience in their respective businesses. All three resided in the Perth metropolitan area but had over the years had travelled

frequently throughout Western Australia's agricultural regions on business. (A more detailed description of the participants is available in Appendix 4).

3.4.6 Responses: thoughts about climate change and causes of climate change

The Familiarisation study showed that the small sample of WA farmers and industry representatives' responses to climate change were similar to responses in Milne et al.'s (2008) study. The critical advantage provided by the Familiarisation study in preparation for the quantitative phase of the research was participants' articulation of their ideas and opinions about climate change and how their ideas and opinions were influenced by their beliefs and values. This provided more detailed insight into why there was variation in the way participants perceived climate change and the associated issues.

3.4.7 Conflict and acceptance between local and scientific information/knowledge

The interviews revealed many of the characteristics of acceptance, doubt, disinterest, dissent and denial described by Langford (2002) and Maibach et al. (2009). However, the interviews also illustrated some of the belief/knowledge dynamics that promoted such characteristics. In addition, the study showed that in regards to climate change, the characteristics of acceptance, uncertainty, doubt, denial and dissent were at times interrelated.

Uncertainty and doubt seemed to evolve from conflict involving participants' experience and knowing what was being communicated by 'experts'. Equally, denial and dissent appeared to result less from a deliberate ignorance or uncompromising refusal to acknowledge climate change and more from a divergence between the participants' knowledge of climate and changing climates and the experts knowledge.

Those who were sceptical or disagreed with the expert view of human-induced climate change did so in the belief that their knowledge was legitimate and therefore valid. This conflict between localised belief and knowledge with scientific broad view knowledge and information could explain the WA farming/rural culture's acceptance of the risk associated with climate/weather variability as normal. For example as some of the farmers commented:

"The climate is dynamic and as result weather patterns frequently change."
"I have been farming for 45 years and I have never seen one season the same as the other."
and
"In the 54 years I have been farming, I have seen many different seasons. ....above average rain, late breaks, early breaks,.. no rain, you name it I have seen it."

As Covello and Johnson (1987) proposed, risk and perceived threat are constructed in a socio-cultural context. In the main, participants expressed views bound by the legitimacy of their experiences and knowledge. It should be noted that sceptical or dissenting views about climate change were based on the same legitimate foundation of local knowledge and experience as opinions that acknowledged human-induced climate change.

That there had been changes in the climate or that the climate was prone to change was accepted by almost all of the participants. Many participants used heuristic functions described by Tversky and Kahneman (1974) as availability anchoring and adjustment to qualify their observations. Perceptions of the permanent or temporary nature of the changes were also constructed from personal knowledge and heuristic assessment. For example, some participants cited severe past drought events as what was described by Nichols (1999) and Tversky and Kahneman (1974) as an anchoring/adjustment mechanism. Their experience and/or knowledge of such events ensured 'availability' of examples with which they could use to make heuristic comparisons with or assessments of what was happening or could occur.

This could be seen in the comments of two participants who referred to previous drought or dryer-than-average periods in supporting their view that while it may have become drier in recent years, there was nothing that had happened before that suggested it would remain that way.

> *"Of course it's changed. …it's always changing. We have had big dries before back in 1940's and 1970's but then its turned wet again"*

> *"I was shearing when Perenjori went through five years of drought in the 1970's….but Perenjori came out of it in the end."*

The inference was that droughts will occur, but no matter how severe the drought, they will end and farmers will recover and farming will return to normal.

The participants' views of the validity of local knowledge at times led into conflict with scientific knowledge. However, it could be suggested that participants were not necessarily questioning the credibility of science but, as Holloway (1999) found with UK farmers, questioning the authoritative position science had assumed in agriculture. As Vanclay (2004) noted, the farming participants were not granting science automatic legitimacy. The insinuation that scientists would use climate change to secure funding and employment tenures could have had more to do with perceptions about scientists' positions in the social dynamics of agriculture than a lack of credibility. Equally, even those participants who agreed climate change was occurring, was human-induced and a threat, felt that as their comments suggest, there should be an equitable cooperative approach between science and farmers to the problem;

"Yes but farmers will need to be a part of it. Science can't go off and decide what's needed."

"It's more about scientists and farmers working together."

However, the Aboriginal participants' views of science's role in climate change were centred as much on people changing their attitudes and behaviours as science providing solutions.

The other issue the Familiarisation study drew out which could factor in rural peoples' perceptions of scientific credibility was science's relationship with government and the issues of trust people had with government. Science is inextricably linked to government in the climate change topic as the 'experts' that could suggest science's credibility may also be linked to rural peoples' trust in the government.

Trust in government seemed to be invoked by supportive actions of the government in times of crisis. This was the case with the participant who had received Exceptional Circumstances Assistance during a drought that had enabled him to continue farming. At the other end of the trust spectrum was the climate change dissenter who thought the government's climate change responses were:

> *"…a … travesty. There are plenty of more important issues out there for agriculture and the country than climate change."*

Government, it seemed, could not be trusted by some to get its policy priorities right.

In the centre of the trust spectrum were the participants who wanted to trust their government but felt circumstances would deem it a forlorn hope. There was an expectation of inevitability that policies for the greater good of broader Australian society would transcend the needs of agriculture and rural communities. One participant articulated this as a sense of alienation from the rest of Australian society and government, which were similar to Australian farming families' responses in Alston's (1996) earlier research:

> *"We were important to the country [Australia]; we put food on the table and brought in export dollars for the country, but not now. No I don't think the average city person cares about the farmers or even cares about where their food comes from so long as they can walk into a supermarket and it's there and it's cheap. The government's the same. As long as we keep paying our taxes they don't care."*

The core point for the issues of credibility and trust could lie with the communication of information and knowledge transfer between science, government and rural people. It has already been flagged that outmoded forms of risk communication are undermining the credibility and trust of government's scientific institutions (Botterill and Mazur 2004).

One of the problems the scientific community could have with communicating climate change information and knowledge to farmers is farmer's knowledge of climatic variability. As Siegrist and Cvetovich (2000) observed, people with little or no knowledge of an activity respond more positively to opinions of experts than those with some level of knowledge .This issue could have been, as Cash et al. (2002) proposed, related to the saliency of the information and the relationship between the information source and the recipient. This was demonstrated in some participants' responses to the potential threat climate change represented.

"I don't know. Anything could be a serious threat in the future. I think we (farmers) have more to worry about than the climate…prices we get for our wool and meat and costs going up…"

"It could be a serious threat, but there's probably as much chance it won't be. The weather or climate…is only one part of farming there are a lot other factors that affect the bottom line."

The medium used to diffuse the information may also dictate the effectiveness of the information transfer as suggested by Brossard et al. (2004). The information and knowledge sources used included general media, special documentaries, family and friends and the internet. Of interest was that only two participants had accessed information from scientific sources. The scepticsm, doubt and uncertainty about climate change threat expressed by some participants suggested there may have been issues with the information sources they used. This presented as a variable that would need to be examined in more detail during the quantitative research.

3.4.8 Psychological influences

The Familiarisation study also revealed two additional variables that could be interdependently related to factors that influenced attitudes to climate change which needed to be included in the quantitative stage of the research. One was the influence that psychological stress and its presence or absence had on peoples' attitudes. The participant who exhibited detachment about climate change commented that he did not get stressed, particularly when it came to the weather and seasonal conditions.

> *"There's no point stressing over something you can't control. I can't control the weather so I concentrate on what I can control."*

Given his apparent detached attitude to climate change, could his response to stress be a case of not concerning himself with an issue over which he had no control, or was it as Kübler-Ross (1969) proposed, a mechanism for denial or alternately acceptance?

The other variable revealed in the Familiarisation study was participants' connectedness to the environment and the potential for environmental connectedness to influence their perceptions and of climate change. It has been suggested that cultural/spiritual connectivity with the natural environment encourages a sense of being an interconnected element within the environment, rather than defining it by its uses or explicit values to humanity (Dutcher et al., 2007). As such, the connectivity creates empathy for the environment, which in turn promotes attitudes of concern and pro-environmental behaviours.

The Aboriginal participants exhibited a cultural connectedness with the environment which acted as a belief basis from which their perceptions of the problem and causes of climate change were drawn from. In contrast, the non-indigenous participants did not indicate connectivity with the environment. Including environmental behaviour variables in the quantitative research offered the opportunity to investigate if there were relationships between environmental connectivity and attitudes to climate change.

3.4.9 Familiarisation study: Limitations and advantages

There were some limitations in application of the Familiarisation technique, particularly in reference to instances when responses were not relevant to the question or participants spent some time focused on extraneous issues unrelated to the research. This posed a challenge because on one hand the objective was to allow participants enough space and time to develop the narrative while on the other hand, time, while relatively generously allocated for the interviews, remained finite.

After several instances during the first two interviews where participants spent considerable time talking about unrelated topics a strategy was employed to ensure participants stayed on topic. The strategy entailed giving participants a brief verbal explanation of the topics which would be addressed during the interview prior to the interview commencing. Although not completely effective, it did provide the opportunity to politely return participants to the topic or question at hand if there was a need.

The advantages of the Familiarisation study approach resided in the layering of additional information around an initial response to a question, which in turn provided a basis of questions to be used in the quantitative stage of the research. For instance, responses to: 'What do you think about climate change?' were not limited to a one dimensional response such as it is happening or it's not happening. For example, participants responded with:

> *"I think people are making a big thing out of it without really knowing what's going on."*
>
> *"Not much. Not the type of climate change the government and scientists are going on about."*

These two responses drew out three core variables to be explored in the survey: uncertainty about climate change; credibility of science; and issues of trust and concerns of government.

One of the major advantages of the Familiarisation study technique was its transferability across a diverse range of social and cultural backgrounds. The technique's strength lay in allowing narratives to develop that assisted participants in maintaining a sense of coherence and meaning, rather than having their train of thought broken by constant questioning. The role of the interviewer was that of an active listener and passive questioner, with questions being used to guide participants through topics and maintain participants' focus on the topic in question. As a result, the influence of the interviewer's language and presence was significantly reduced, while at the same time the participants' narrative discourse was a central and major feature of the interview. This was the case regardless of whether they were the male or female farmers, agribusiness representatives or the Aboriginal farmers.

The information derived from the Familiarisation study highlighted the value of the mixed method approach to this research, particularly in designing the survey questionnaire. The small sample of farmers, agribusiness representatives and Aboriginal landholders who took part in the Familiarisation study provided a cultural framework within which to develop the questionnaire. Instead of survey questions being constructed from previous research results or using results derived from preconceived testing in a pilot study, the research was able to progress to the quantitative stage with a strong element of socio-cultural relevance in the questions and the language used in the questionnaire. Essentially the structure, language and questions in the survey questionnaire were strongly influenced by responses of participants in the Familiarisation study interviews.

3.4.10 Discussion

The results of the Familiarisation research suggested there were a number of topics to consider when formulating the quantitative stage of the research. To begin with there appeared to be a need to not only clarify rural peoples' acceptance or non-acceptance of climate change but to clarify if rural people thought climate change was natural or caused by human activities. The Familiarisation research indicated

that rather than people having two distinct views of climate change, being either acceptors/believers or dissenters/sceptics, there was the possibility of holding alternate views or being doubtful and/or uncertain.

Perhaps some of the most pertinent questions for the research to address were: If there was a relationship between rural peoples' observations of changes in their local climate (if they had indeed observed changes); Their attitudes to the changes in local climate; If they perceived risk/threat in the changes; and if the attitudes they founded on what they had experienced in a localised space extended to broadview perceptions of climate change and its overall potential threat.

Similarly, in regard to science's role in climate change the Familiarisation research indicated some conflict and tensions between participants' perceptions of scientific credibility. The quantitative research thus needed to explore three main areas in regard to rural peoples' attitudes to climate change science. The first approach was to address rural peoples' perceptions about science and scientific credibility. The second approach was to explore rural peoples' attitudes to scientific knowledge and information; that is, to see if rural people felt that science was a relatively sound source for climate change knowledge and information. The final area of investigation in regard to science's credibility was the alternate information and knowledge sources rural people used and how science's credibility compared with these sources.

This approach to exploring the credibility of climate change science offered the opportunity to investigate the presence of relationships between rural peoples' perceptions of scientific credibility and their attitudes to climate change. There were at least two key questions that could be drawn from the Familiarisation study concerning this. The first question being: Was there a relationship between rural peoples' perceptions of scientific credibility and acceptance or scepticism of climate change? Secondly, did conflict in some areas of science's credibility contribute to uncertainty or doubt in rural peoples' attitudes to climate change?

Finally, the lack of confidence participants expressed in government's responses to climate change suggested this was another area to be addressed in the quantitative research. The questions posed to participants concerning their lack of confidence in government: Did poor government credibility and trust influence rural Western Australians' attitudes to climate change? and; Would poor government credibility

and trust impinge on rural Western Australians' acceptance of policy responses to climate change?

3.5 Quantitative research design

A key component in examining the drivers of rural peoples' attitudes to climate change was investigating the relationships between their beliefs and local knowledge of the climate and perceptions of climate change, science and government. Following Dalton et al.'s (2001) study, the aim in undertaking the quantitative stage of the research was to investigate if there were statistically significant interdependent factors or variables that either singularly or in aggregation influenced attitudes.

To collect relevant data within a set period of time, a structured survey was considered to be the most appropriate method. Use of the survey method proposed by Dalton et al. (2001) offered the advantages of collecting responses to a large number of variables in a relatively short period of time at a limited number of locations from a potentially large target population. The decision to collect information in a short time frame was influenced by concern that reporting through the popular media of political situations could affect peoples' perceptions/attitudes of climate change. Unger (1992) observed that "social scares" reported through popular media could "accelerate political demands", which could then become the basis for social change. To this end, it was important for the research that rural peoples' perceptions/attitudes to climate change represented a comparative sampling and thus reflected a particular period of time so as not to confound results.

The survey was primarily conducted via personal intercepts during field day events and at the secondary location of the Perth Royal Show. If it was inconvenient for participants to complete surveys at the locations via personal contact, alternative arrangements were made. These arrangements entailed the survey and a return address envelope being given to participants with a cover letter explaining the survey and the purpose of the research. The data collector would brief the participant on response procedures and ensure the participant understood how to correctly complete the survey.

Alternatively, a number of potential participants indicated they wished to complete the survey via telephone. In these instances the participant either provided contact

details, which were passed on to me, or if unwilling to pass on contact details were directed to contact me at the phone numbers provided on the survey cover letter.

These alternative data collection methods were used because of time and logistical limitations related to the research. The time frame for the survey period and the restricted availability of resources, travel and expenses needed to conduct every survey on a face-to-face basis were contributory factors. Each major survey location was some distance from the Perth metropolitan area and travel and accommodation expenses precluded additional time being spent in the locations.

3.5.1 Sampling strategy /methodology

In seeking to explore rural Western Australians' attitudes to climate change the research was, in essence, examining attitudes of Western Australia's broader rural community within a socio-cultural and geographic framework. As Wardell-Johnson (2007) noted, in the most general terms this could be taken to mean people who live in specific geographic locations. A more nuanced definition would extend the definition of a rural community beyond that of geographic locations to include what Halfacree (1993) described as a sense of socially constructed identity and place. A rural community can therefore be defined, as Phillips (1998) has, as less a physical place and more a subjective mindset of rural identity derived within a socio-cultural context. As the research objective was to explore the collective attitudes of rural Western Australians to climate change, the sampling methodology was based on participants' subjective interpretation of rural identity (Phillips, 1998). Essentially participants were:

- Involved in agriculture in some capacity: farmers, farming family members who either worked on the farm in full-time paid employment, or contributed on a part-time or seasonal basis or when they were able to. (This included family members who were students, worked off farm or were retired/ semi-retired). Also included were those who owned or were employed in agribusinesses based either in rural communities or in the metropolitan area.
- Employed in or owned non-agricultural/farming businesses, professions or service industries in rural communities.

- Lived in rural communities, but did not work or own businesses in rural communities. These participants included people who had retired to rural communities or were fly/drive in employees in mining or other industries.

The research sought to capture data within what was exclusively a rural socio-cultural framework encompassing the diversity of social structures, landscapes, climate and farming systems represented in Western Australia's agricultural regions. To that end, place, timing and format for delivery of the survey were a major consideration requiring an effective strategy to maximise participant intercepts and data collection.

3.5.2 Research delimitations and assumptions

Delimitations of the research project were:

1. Analysis and results would only be undertaken from data drawn from designated survey locations during the time period allocated to survey data collection.
2. Locations designated as survey contact points were:
   - Dowerin GWN Machinery Field Days held on the 27th-28th August 2008
   - Newdegate Machinery Field Days held on the 3rd-4th September 2008
   - Mingenew Lions Midwest Expo held on the 18th-19th September 2008
   - Muresk Open Day held on the 7th September 2008
   - Perth Royal Show held on the 27th September-4th October 2008
   - Waroona Agricultural Show held on the 10th October 2008
   - Department of Agriculture and Food WA Katanning Field Day 24th October 2008
3. Surveys were conducted via personal contact or distributed to participants to be completed at a more convenient time and mailed via return addressed and stamped envelopes provided by data collectors.
4. In addition, provision was made at the request of participants to complete the survey via phone at a suitable time.
5. Data collection commenced September 27th and terminated November 30th. Only data collected during this period was analysed.
6. The research sought to describe a representative selection of rural Western

Australians' attitudes to climate change and the influence rural peoples' perceptions of scientific and government credibility had on their attitudes to climate change, along with other factors influencing attitudes and implications associated with rural peoples' attitudes to climate change.

7. The research did not seek to examine or describe in detail intimate personal social or emotional reasons for peoples' attitudes to climate change.
8. The research sought to identify issues related to communication or diffusion and adaptation of climate change information and innovations that could be considered for future study.

In keeping with a post-structural approach to the research, prior assumptions during the quantitative stage of the research were as Kendall et al. (1993) had directed, kept to a minimum. The assumptions the research was based on were:

- People attending the field day events were interested in rural issues.
- People were aware of climate change and or the general discussion of the topic.
- People made use of print and electronic media sources for information.

The range in participants' responses to the subject during the Familiarisation study interviews highlighted the need to ensure that the survey was conducted in locations that represented the range and diversity of WA's agricultural industry and climatic conditions. In response to this objective it was decided to conduct the research primarily during three major agricultural Field Day events which occur annually in WA between August and September.

However, it was recognised that these field day events were located in broadacre farming regions and focused mainly on traditional broadacre enterprises of grain and livestock (sheep meat/wool and beef cattle) production (ABS, 2006). It was important for the research to have as broader representation of WA rural people as was feasible including people living in regions outside the field day events and involved in alternative farming enterprises and systems. Provision was therefore made to conduct the survey at a number of secondary locations that reflected the diversity in agricultural systems and climate within Western Australia (ABS 2006, 2006a).

Locations chosen to meet this requirement included the Perth Royal Show, Waroona Show, Muresk Open Day and the Katanning Crop and Pasture field day. These secondary locations offered opportunity to include landholders involved in dairy, viticulture and horticulture, as well as community members not involved in agriculture from the various regions (ABS, 2006).

3.5.3. Survey questionnaire design

Design of the survey questionnaire was undertaken as outlined by Oppenheim (1992). The importance of determining the information needed for the research was considered, while at the same time ensuring the potential for bias and response error was minimal. As the survey would be conducted by an interviewer and in certain circumstances would be self-administered by participants, Jenkins and Dillman (1995) maintained that it was important to ensure the document was easy to understand and follow. Participants would, in the first instance, need to be able to understand the information and then understand the visual and verbal features of the survey.

Close attention was paid to format, structure and wording of questions, with particular attention given to the comprehensibility of questions. The aim was to avoid ambiguity in the meaning of the questions and participants' responses, which Gendall (1998) suggested could occur without due care. The survey was developed over four weeks through an iterative process of frequent discussion, critical evaluation and reflection between the researcher and research supervisors. During this time the survey was tested and re-tested for coherence, meaning and comprehensibility, as well as identifying and eliminating repetition.

The questionnaire was developed at the conclusion of the qualitative stage of this research. The discovery process of the Familiarisation study had revealed a diversity of attitudes to climate change ranging from acceptance, uncertainty and doubt through to dissension. Equally, participants had exhibited a range of values, beliefs and ideas that appeared to contribute to their attitudes about climate change. Details of participants' responses during the Familiarisation study are examined in Chapter four with copies of their interviews in Appendix one.

Questions for the survey were also developed from other sources. These included other Australian studies such as the MDB study (Milne et al., 2008), ABS Farm Management and Climate survey (Pink, 2008), the DAFWA (2006) report on public consultations of climate change and adaptation in WA, as well as Wardell-Johnson's (2007) research. Further to this, risk management literature, industry and DAFWA sources were also utilised during the questionnaire development. The development of questions concerning information sources and networks was assisted by Wardell-Johnson's (2007) research and experience derived from other work (Wardell-Johnson, 2005).

To ensure that participants viewed the survey with a level of interest and were encouraged to respond, the cover page of the survey highlighted in an outline the relevance and salience of objectives and aims of the research. Research indicated that including relevance and salience was vital in engaging participants in the survey (MRS™, 2006), as well as building a rapport between interviewer and participant (Guillemin and Heggen, 2008).

The final design of the survey was structured around four sections, comprising one hundred separate questions covering different areas of interest for the research (See Appendix 4). These sections were:

Section 1: Involvement in the rural sector

The first section of the survey comprised fifteen questions which were split into a general section for participants and a specific section only for farmers. There were sixteen questions in total with non-farmers having the choice to respond to the first six questions that addressed involvement in farming, rural communities, non-farm business interests, non-farm work and where people lived and for how long.

This section sought socio-demographic and geo-demographic information to allow opportunities for comparisons within rural communities' social structures as well as between businesses and farms and agricultural regions. Demographic information would be compared with Australian Bureau of Statistics (ABS) data including regional profiles of Western Australia (ABS, 2006), community profiles (ABS, 2006a), Western Australia's statistical local areas (ABS, 2006b) and the demographic summary of Western Australia's statistical divisions (ABS, 2007).

The second section for farmers included nine questions related to personal and family history in farming, farming enterprise, location and size of the farm/farms and membership of farmer/industry and/or Landcare organisations. The inclusion of these questions was promoted by responses in the Familiarisation study which suggested correlation with past studies. These responses indicated that local knowledge derived from personal and significant historical experiences acted as a basis for validating participants' attitudes to climate change. Past studies had suggested relationships between peoples' sense of place and identity derived from personal, social and historical aspects and the attitudes they held toward the environment (Wardell-Johnson, 2007; Stedman, 2003; Chawla, 1998). There was also evidence that the length of time farmers had owned a property defined their typological characteristics in attitudes to changes in land use and forces evoking changes in land use (Bohnet, 2008).

To complete this section, participants were asked if they were members of a farmer group/ industry organisation and Catchments/Landcare groups. The questions were included to examine if there was evidence that membership of industry groups and Landcare groups influenced rural peoples' perceptions and responses to climate change risk.

Conflicting conclusions had emerged from earlier studies of Australian farmers attitudes' to rural environmental issues. Webb (2004) had suggested that long term membership of Landcare groups could contribute to changing farmers' attitudes to the environment. In addition, it had been found that farmer/landholder environmental behaviours and attitudes were responsive to the frequency of involvement in Landcare activities (Cary et al., 2001). However, other studies had found there was not a strong relationship between membership of Landcare groups and changing environmental attitudes (Reeve, 2001). Nor did it appear that there were distinct differences in environmental stewardship attitudes between those who belonged to Landcare groups and those who did not (Curtis and DeLacy, 1996).

Section 2: Personal perceptions of climate change

The second section of the survey included seventeen questions, of which ten were for only farmers, rural business and agribusiness representatives. These questions explored business participants' experiences with poor seasons and their strategic

business responses to the poor seasons. The second part of the section included all survey participants and examined if people had noticed changes in the climate and explored if they thought the changes were related to climate change or were normal.

The questions were designed to establish a baseline of farmers and business representatives' experiences of poor climatic conditions, against which their more subjective assessments of the local climate could be compared to.

Questions for this segment were drawn from discussions with the Geraldton Department of Agriculture and Food WA staff, three farmers from the Northern Agricultural Region (NAR) and several DAFWA staff from southern agricultural regions.

The impact of stress caused by economic issues related to poor seasons was also addressed in this section. Paterson and Neufeld (1987) observed that psychological stress derived from adverse experiences could heighten expectation of impending threat or risk, which could act as catalyst for attitudinal behaviour change. In addition, Alston (1996) had noted that farmers face not only stress derived from economic issues during drought but also forms of spiritual stress as the aesthetics of the farm environment are degraded by the effects of drought.

To complete the first part of section two, farmers and business representatives were asked to give a subjective assessment on how they managed the poor seasons in comparison to other farms and businesses in their district. The aim of the question was to examine the potential for managerial and optimistic biases by comparing the responses to their subjective assessments of impacts of poor seasons and perception of climate risk. Research had suggested managerial and or optimistic biases could reduce perception of risk and inhibited planning for contingencies (Larwood and Whittaker, 1977; Weinstein, 1989).

The second part of section two sought to establish a baseline for the extent of observed changes in the local climate and if participants linked changes to climate change. Previous studies had found there was ambiguity among rural Australians concerning observed changes in local climate and linkages to climate change (DAFWA, 2006; Fleming and Vanclay, 2009; Milne et al., 2008). The questions were designed to more fully explore and provide deeper insight into relationships

between what rural people had observed and their evaluation of the situation. Responses during the Familiarisation study had indicated that attitudes to changes in the local climate could influence attitudes to climate change.

Studies had indicated if changes in local climate were perceived as naturally cyclical and considered to be in the accepted range of variability, participants were less likely to link the changes to climate change or potential threat (Finucane, 2000; DAFWA, 2006; Milne et al., 2008). Alternately, if the changes in local climate were thought to be outside the accepted range of variability, participants were more inclined to accept the changes were part of climate change.

Section 3: Attitudes to climate change

This section of the survey was divided into four parts. The first part comprised three questions regarding participants' attitudes to climate change and four questions about their disposition towards responding to climate change. Questions were designed to compare with two questions on the subject posed in the MDB study (Milne et al., 2008). The Familiarisation study had also revealed a level of uncertainty about climate change occurring and what was contributing to the change. This uncertainty had also been drawn out in the earlier public consultations undertaken by DAFWA (2006).

The second part of the third section had nine questions that looked at participants' opinions about the role of science in climate change, including the credibility of science. Studies have indicated that scientific credibility is a key factor in the effective transfer of information and knowledge to the public (Langford, 2002).

Perceptions of the credibility of science during the Familiarisation study were generally good. However, most participants felt responses to climate change should be a collaborative action between science and the rural sector, with a strong emphasis on close cooperation. The main source of doubt concerning the credibility of science was derived from perceptions that science and scientists had a vested interest, specifically a financial interest, in climate change. This perception of doubt derived in a sense from distrust has been described in past studies (Stoll-Kleemann, O'Riordan and Jaeger, 2001).

Divisiveness within the scientific community was another distinct element that had been shown to contribute to public perceptions of scientific credibility (Langford, 2002). Although debate and the evaluative review process used to validate the legitimacy of knowledge is a prerequisite within the scientific community, the public can perceive such a process as portraying divergence and uncertainty.

Further development of questions examining other characteristics that could contribute to rural peoples' perceptions of scientific credibility included an evaluation of trust shown by research to be based on expertise, transparency, honesty, empathy and care (Botterill and Mazur, 2004; Peters, Covello and McCallum, 1996). This specifically related to the possibility that some scientists may have a vested interest in climate change in terms of accessing research funding or furthering careers. In addition, two questions explored the capacity of science to meet the challenges of climate change. One question was posed in general terms as to whether science could solve the climate change problem. The other question examined the potential for cooperation between science, the agricultural industry and rural communities in seeking solutions to climate change.

The third part of section three was made up of eleven questions that explored participants' views of government's (Australian Federal and State) role in climate change and the credibility and trustworthiness of government and politicians in that role. The final part of section three included separate question sets for only farm and other business participants. The issues explored were derived from research which indicated that rural people felt government had become disengaged from the rural sector and to a large extent the rural sector was not a primary consideration when policy was being formed (Alston, 1996). The Familiarisation study had revealed that in addition to this sense of alienation, there was uncertainty of government's intentions and if the rural sector would be treated equitably within the climate change policy processes.

Questions concerning Exceptional Circumstances (EC) Assistance were included in this part of Section Three. EC Assistance was the Federal government's drought relief policy and as such represented government's direct response to the impact of drought on the rural sector (Department of Agriculture, Fisheries and Forestry (DAFF), 2008). At the time the survey was being conducted, a national review of

drought policy was being undertaken and a call for submissions to the Productivity Commission had been made (Productivity Commission, 2008).

As part of the submission process, "WA Farmers" approached the research team with a request to include a series of questions in the survey related to EC assistance in order to provide relevant information for the "WA Farmers" submission (McMillan, CEO, WA Farmers, pers com, 2008). As the topic had relevancy to the research in that rural perceptions of policy responses to impacts of adverse climatic conditions were being addressed, the research team agreed to WA Farmers' request.

Part four of Section Three examined participants' perceptions of future climate change threat to rural communities and farms/businesses. International (Anable et al., 2006) and Australian (Milne et al., 2008) studies had shown that although there was concern about climate change there was also an overarching ambivalence concerning climate change threat. Ambivalence to climate change threat emerged during the Familiarisation study as well. Responses during the study suggested there were other issues considered more important and more of a priority than climate change. Therefore, questions were developed to not only draw out the value ascribed to climate change threat, but also to explore how threat of climate change compared to other short and long term economic imperatives such as costs of fuel, fertiliser and chemicals as well as interest rate issues, environmental sustainability and labour shortages.

The final eight questions in the section examined the values participants attributed to the climate change views and opinions of various social relationships: micro (family/friends/neighbours), meso (community groups including school P&C's sporting clubs and industry and Landcare groups) and macro (climate change scientists and policy makers) social structures.

Section 4: Climate change information sources

This section investigated characteristics of climate change information exchange and knowledge transfer within and between micro social structures (family, friends and neighbours), meso social structures (informal and semi-formal community groups/organisations) and macro social structures (formal organisations such as government and science and informal institutions such as religion, education and finance). The aim of these questions was to draw out information regarding

interactions within farming communities and between farming communities and government, science and other formal institutions which had been present in other research (Falk and Kilpatrick, 2000). It had been suggested in some research that environmental issues such as climate change could be subject to a culturally based construction (Brossard et al., 2004). As it was, the exchange, knowledge evaluation and transfer of environmental information between social structures had been shown to be an iterative process reflecting socio-cultural complexities (Wardell-Johnson, 2007).

In addition to these complexities was the general media's role in communication of climate change information. While it is generally accepted that journalists will act as unbiased communicators of scientific information without invoking journalistic investigation, the media with or without intention can exert undue influences (Meyer, 2006). Antilla (2005) questioned if the media as the most accessible and personal point of information communication had a capacity and opportunity to shape information and thereby influence public perceptions of climate change issues. The Familiarisation study also reiterated the media's role as a primary source of climate change information, along with some elements of micro social structures (family, friends and neighbours).

The survey concluded with questions that addressed environmental behaviours already being undertaken by participants. The aim was to identify parallels between participants' environmental behaviour responses and their attitudes to climate change. The questions were drawn both from the Familiarisation study and a review of the literature. During the Familiarisation study the Aboriginal participants had exhibited strong pro-environmental connectivity which could be seen to contribute to shaping their attitudes to climate change. The literature had also shown evidence of relationships between early established environmental values in childhood and pro-environmental attitudes and behaviours later in life (Dutcher, Finley, Luloff and Johnson, 2007; Barr, 2007).

The final questions of the survey were age and gender demographics. These were added to responses drawn from Section one of the survey during analysis.

3.5.4 Value and labelling of scaled responses

A seven point Likert scale was chosen as the most appropriate option for ascribing a value to the data to facilitate statistical analysis (Business Dictionary, 2012). Although the Likert scale is generally used with five potential choices of value, the choices used can be up to ten or more. A seven point Likert scale was used in the survey to provide greater insight into the degree in range and variance in attitudes. Research has shown that reliability and validity of data improved as the number of response choices increased to seven alternatives (Lozano, Garcia-Cueto and Muniz, 2008). Lozano et al. (2008) also found that with less than four alternative responses, reliability and validity decreased while there was little increase in the psychometric properties of the scale if more than seven choices were offered.

To capture the scope and variance of responses the seven point Likert scale used ranged from: 1 = 'Strongly disagree', to 7 = 'Strongly agree' and was used for most questions, although there was some variation for specific questions. An additional point was added to the scale, designated 9 for 'Don't know' (Appendix two).

Variations of the scale used during the survey included different labelling for the seven point scale and use of a four point Likert scale with alternative responses. Variations of scale labelling for the seven point scale were: 1='Not at all', to 7='A lot'. Labelling of scales for the four point Likert scale include 0='Not at all' to 3= Value highly' and 0='Not at all important' to 3 ='Most important'.

Use of a reduced number of alternatives for some questions was employed to address time constraints of the survey. The application of other coding responses was an attempt to follow the principles of familiarity advocated by Whiteley and Whiteley (2006). While application of these methods did not compromise the integrity of information, it did complicate and unnecessarily increase difficulty in the analytical processes. The variation in scale and response coding did restrict opportunity to more fully explore interdependent relationships between variables using SPSS analytical software (SPSS, 2009). Fortunately, utilisation of numerical taxonomy analysis with PATN software (Belbin et al., 1993a) compensated for these shortcomings (see Section 3.8, Analysis of the survey data). In addition, limited data was collected via nominal methods to provide qualification of some socio-demographic characteristics in the survey sample.

3.5.5 Pre-testing the survey

Due to time constraints, pre-testing of the survey was limited. It was only possible to test the survey on five individuals who in general terms were representative of the target sample. However, the survey document was emailed to selected researchers and lecturers from Curtin University, School of Agriculture and Environment, as well as a number of WA Agriculture industry and DAFWA representatives for review. All aspects of the survey were examined with attention paid to structure, wording, comprehensibility, format and sequence of questions and instructions. There were no problems with the survey indicated from the pre-test and academic and industry review.

3.5.6 Adjustments to the questionnaire

After the first survey period during the Dowerin Field-days, some slight adjustments were made to the survey document. Several minor issues with the survey had been identified by the interviewers. The interviewers reported some participants who had wished to complete the survey themselves found it difficult to read because of the style and font size of the print. Both the interviewers and several participants had also commented some questions were too "wordy". The interviewers had found the "wordy" questions were difficult to read out loud to participants. It was also found that participants could not see the need to differentiate between selling business assets and personal assets due to effects of poor seasons. Many participants considered the two questions as an unnecessary doubling of what they in effect believed was only a single question.

After consultation with the research advisors, these issues were addressed. Font style was changed to Arial which is easier to read using the same font size. The "wordy", difficult to read questions were simplified without compromising the intended meaning of the questions. During consultation with the research advisors, it was pointed out that 'Farmer and Industry Groups' had been omitted from the questions where participants rated the value of various groups of peoples' views of climate change. After discussion, it was agreed to include 'Farmer and Industry Groups' in the questionnaire for the remainder of the survey period.

Finally, the two questions concerning the sale of business and personal assets were combined to a single question of 'assets had to be sold'. An examination of responses from the Dowerin survey showed a majority of participants had responded the same to both questions. To maintain integrity of the data it was decided that during data entry, any responses which were not the same would be excluded. As a result, of the 129 participant responses from Dowerin only six were omitted and recorded as missing.

3.6 Field work: Rural Western Australians' climate change survey

The survey sample of participants was a composite representation of people from the broader Western Australian rural population social structures and 'Rainfall Zones' (see Appendix 6). Research deductions were made from participants including farmers from various agricultural regions utilising a range of farming systems; agricultural and non-agricultural rural business representatives; and community members not involved in agriculture (Dalton et al., 2002). The quantitative stage of the research commenced with surveys conducted primarily via personal intercept at field day events held in the townships of Dowerin, Newdegate and Mingenew during August and September 2008 (Figure 3.1).

Studies had shown that personal interview intercepts offered the data collector an element of control in the survey questioning process and the capacity to confirm responses (Malholtra, Hall, Shaw and Oppenheim, 2002). In addition, personal contact offered an opportunity for data collectors to observe participants' comments and reactions to the questions. Teddlie et al. (2007) suggest that this could provide added depth and texture to the research. An interview team was assembled to undertake the surveys, comprising myself, a female colleague and two male colleagues. All had some experience in conducting surveys and market research.

During the primary stage of data collection at the Dowerin, Newdegate and Mingenew field days the interview team commenced surveying when venues opened (Figure 3.1). Surveys were conducted over the course of the day and ceased in the early evening. Generally the interview team spent between seven and eight hours a day conducting the surveys.

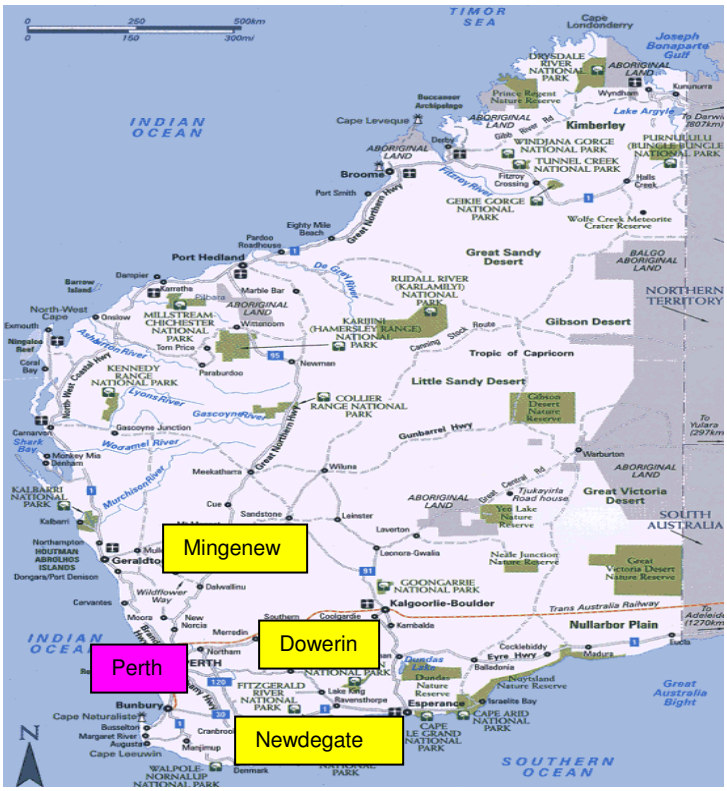

Figure 3.1 Map of primary survey locations

Prior to commencement of the survey period, organising committees of the field days were contacted to request permission to conduct survey interviews during the duration of the events. All organising committees or representatives gave permission and also extended offers of support to the research for the duration of the events. The main form the support took was ongoing publicity conveyed by public address announcements at regular intervals during the day, encouraging patrons to participate in the survey if approached. A brief outline of the research was included in the announcements. The outline of the research was available in written form and was given to participants prior to the interview commencing to explain the purpose of the research. The outline of the research was also included with return mail surveys. (See Appendix three for a copy of the research outline).

The survey period commenced on the morning of 27th August 2008; the first day of the Dowerin GWN Machinery Field days (Figure 3.1). The interview team arrived as the event was opened to the public. Before commencing the survey interviews, contact was made with event organisers. Upon completion of this task the interview team commenced approaching and interviewing event patrons. This approach was also used at the other two field day events.

The plan was for the interview team to work independently at different locations around the event site. The interview team used simple random sampling regulated by a predetermined number and would then proceed to approach people to take part in the survey. In this instance the number was four. This determined that interviewers would approach every fourth person that they were to pass or walked passed them if they had taken up a fixed position in an area of the grounds. Use of random sampling ensured participant selection was based on set probabilistic chance (Leedy and Ormrod, 2001).

An initial problem with the interview process was associated with the time taken to complete the interviews. The first few surveys had taken between 25 and 30 minutes to complete. This was due in part to the time it took interviewers to read questions and participants wanting to either discuss questions during the interview or discuss the topic further after completion of the survey. There was also an issue in encouraging people to participate in the survey while they were viewing exhibits.

After a brief discussion the approach was altered to target food and beverage sites. Most of the food and beverage areas at Dowerin and the other field day locations provided tables and chairs. The survey team found that people more likely to participate in the survey if they were able to sit down, or while they were eating or drinking. The change in approach resulted in a more favourable participation response. As a result, this strategy was applied during the survey process at the other field day locations.

Following the Dowerin GWN Machinery field days, surveys were conducted at the Newdegate Machinery Field days (3rd-4th September). Organisers provided generous support for the research and encouraged patrons to participate in the survey if approached. Despite improving the format and structure of the survey document, the team found that it was still taking approximately twenty five to thirty five minutes to complete the survey. This was due mainly to the way participants were responding. Generally, it was found participants were interested in the topic and were inclined to express their opinions and ideas at length during and after the survey. As a result opportunities to conduct more surveys were restricted.

The Mingenew Lions Midwest Expo was held on the 18th and 19th September, two weeks after the Newdegate event. The interview team consisted of three individuals.

This event had fewer food and beverage facilities concentrated in one particular area of the arena. This limited opportunities to conduct surveys. However, despite the limitations, Mingenew as part of the Northern Agricultural Region (NAR) offered the opportunity to observe the effects a recent prolonged and unprecedented drought may have had on participants' attitudes to climate change.

Discussions with Geraldton staff from DAFWA and observations made during a presentation by senior DAFWA management in April 2007 suggested that NAR farmers were accepting the occurrence of climate change. Staff based this conclusion on a high number of farmers (approximately 230) who had attended a Geraldton DAFWA climate change workshop conducted earlier in 2007 (Bowley, Director, DAFWA, NAR zone, pers com, 2008). Undertaking the survey in the NAR also afforded an opportunity to compare responses and attitudes between NAR residents and farmers with responses of residents and farmers from other agricultural regions that had not experienced such a drought.

In addition, there was a distinct difference in seasonal conditions between each of the regions where the field days were held during the survey period which could be compared in analysis. The central part of the Avon Region, which included Dowerin and surrounding districts, had been experiencing dry conditions at the time of the survey. Local farmers confirmed crops and pasture were suffering moisture stress and many shires in the Avon region were in dire need of rain. Generally, farmers were not hopeful of a good seasonal outcome.

On the other hand, Newdegate and the Great Southern Region had received good rainfall during the growing season and farmers and business people at the Newdegate Field days were very optimistic about the season's outcome. The NAR was generally in a more advantageous position than the Great Southern Region. During the Mingenew event, several farmers commented that the 2008 season was shaping as one of the best production seasons they had experienced. The farmers believed the way the season had developed would result in extremely high yields that had potential to significantly reduce debt incurred during two previous years of drought.

At the same time as surveys were being conducted at the Dowerin, Newdegate and Mingenew field days, surveys were distributed during an Open Day at Curtin University Muresk Campus (Figure 3.2). These surveys were self-administered by

participants and returned by mail. Further personal contact surveys and distributed surveys for participants to self-administer were carried out during the Perth Royal Show (Figure 3.2). Surveys were also conducted and distributed on the 10th October when two of the interview team travelled to the Waroona Agricultural Show (Figure 3.2). The final surveys were distributed during the Katanning Pasture field days (Figure 3.2) by a senior DAFWA staff member who had offered to promote and distribute the survey.

As was the case prior to the surveys being conducted during the field day events, organisers or the relevant authorities of events were contacted to request permission to undertake personal interviews or distribute surveys during events. Again, approval was given along with offers of additional support.

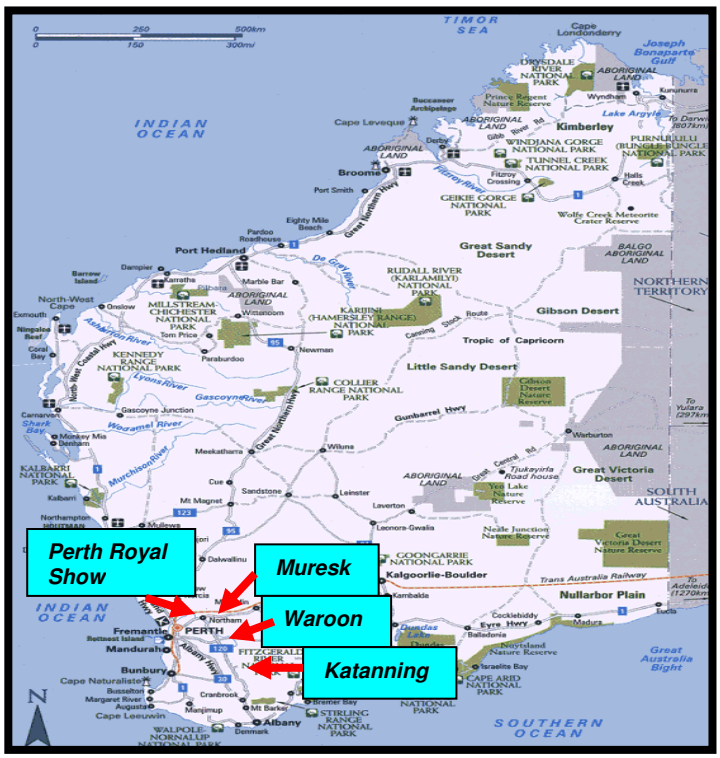

Figure 3.2 Map of secondary survey locations

Surveys at these locations also allowed for greater inclusivity of rural social diversity in the research. It was acknowledged that certain rural social assemblages may be excluded from the research due to locations, timing and broadacre themes of the field days survey locations. These secondary locations offered access to people who may not have been represented in the research including, rural youth, small landholders,

and rural industry and community representatives based in the South Coast and South West Coastal agricultural regions.

3.7 Data Entry

Data analysis was undertaken with Excel 2003, PASW® Statistics GradPack 18, Windows® (SPSS, 2009) statistical software and Numerical Taxonomy using PATN, 2.3, Windows software (Belbin, 1993a). Univariate, bivariate and multivariate analysis was used to establish if there were significant differences between groups of responses, explore associations between variables and examine if there were statistically relevant relationships between people and values.

All questionnaires were checked to ensure that responses had been correctly recorded, with no more than one response per question. Questionnaires were also checked to ensure that deliberate response error had not occurred. Three questionnaires were found to have been filled out in a deliberate basic pattern and were excluded from data entry.

After the data had been checked it was entered into SPSS data spread sheets for analysis. Alternately, the numerical taxonomy PATN Windows program (Belbin, 1993b) required a different data entry format to that of SPSS. The data was entered into Excel on a presence/absence basis and then pasted into a PATN matrix which was then checked by research advisors before analysis was undertaken.

3.8 Analysis of the Survey Data

To begin the process of data analysis a univariate analysis was undertaken to show distribution of frequencies and percentages of all questions in the survey. The univariate analysis is essential to the analytical process as it presents a basic overview of responses and can give direction to ensuing analysis of the data (Leedy et al., 2001). In addition, outcomes of the univariate analysis have a function in providing an understanding of results.

Bivariate analysis using independent T-tests were carried out to determine if there were differences between groups in the survey sample (Coakes and Steed, 2007). For example, this was used to test if responses to climate change were significantly different between genders and non-farmers and farmers.

Cross tabulations using chi-squared nonparametric techniques were used to test the data for goodness of fit and independence or relatedness (Coakes and Steed, 2007). The purpose of

these tests were to see if there were any differences between groups or within the survey population of attitudes to key variables related to climate change, responses and science and governments' roles in climate change.

Analysis of variance (ANOVA) was used initially to investigate the differences in mean values of dependent variables of a number of single independent variables using a post-hoc analysis (Coakes et al., 2007). A full analysis was undertaken using ANOVA to check significance of differences. The 'Sidak' Post Hoc Test was used to see which questions were significantly different if the 'Homogeneity of variance test' showed no significant differences (>0.05), indicating a normal variance distribution. If the 'Homogeneity of variance test' showed a significant difference (<0.05), which indicated a non-normal variance distribution, the 'Brown-Forsythe' and 'Welch' tests were used to check significance of differences and the 'Tamhame' Post Hoc Test result was used to see which questions were significantly different.

Analysis of variance (ANOVA) was primarily utilized was to see if there were significant differences of attitudes between and within groups of participants to climate change, climate change science and the role of government in climate change. Groups were initially defined by associations of extrinsic characteristics and intrinsic values derived from a multivariate analysis (PATN 2.3; Belbin, 1993a). For example, the groups tested and compared were based on the following characteristics: farmer, non-farmer, landholder, shire lived in, time involved in farming and time lived in an area, as well as defined climate change values .

Factor analysis, a data reduction technique, was used to condense the large number of variables in the survey into smaller groupings of core factors (Coakes et al., 2007). The technique employing Principle Component Analysis (PCA) with Varimax rotation and Kaiser Normalisation was used to reveal underlying constructs that described the percentages of variance in participants' attitudes in the results (SPSS, 2009).

Researchers involved in identifying farmer typologies have advocated the use of multi-variate analysis techniques such as Principle Component Analysis, Cluster Analysis (Jennings and van Putten, 2006; Köbrih et al., 2003; Kuehne et al., 2007; Van Herzele and Van Gossum, 2008) and Logistic Regression (Van Herzele and Van Gossum, 2008). Numerical taxonomy uses a multivariate approach using standard descriptive statistics as well as numerical classification comprising cluster analysis and multi-dimensional scaling ordination. In addition, network analysis was used to extend analysis of the data. Numerical taxonomy allows simultaneous numerical classifications that avoid hierarchical approaches

and compounded errors. The development of this approach has been facilitated by parallel developments in computer based approaches (Wardell-Johnson, 2005).

Explorative analysis of the data simultaneously assesses relationships between cases and variables that portray relationships of people with values through clustering, ordination, networks and statistical evaluation without excluding outliers from the data. The analysis is not reliant on a normal distribution of data or the requirement to base decisions on prior assumptions of importance about specific independent and dependent variables. Application of numerical taxonomy in this form provided a validation that emphasised characterisation of individuals clustered in social groupings (Wardell-Johnson, 2005). This was done by a process which identifies similarities between individuals clustered in social groupings and clusters of attributes which examined the strength of these connections. The cases were then represented in an abstract ordination indicating relationships between individuals based on the variables. The results were then evaluated for statistical significance.

Numerical analysis processes were used to examine patterns drawn from the analysis. Standardising and quantifying differences between groups was undertaken with the Bray Curtis metric: $D = \sum \left| Dik - Djk \right| / \sum (Dik + Djk)$ (Bray and Curtis, 1957). Clustering of matrix data from the survey was carried out using unweighted pair group arithmetic averaging (UPGMA). The Two Step metric, D $\left| 0\text{->}1 \right| R \left| 0 \right.$ x 0 (Belbin, Faith and Minchin, 1984) with Beta set at -0.1 was used to obtain groups of variables from the data. Kruskall-Wallace tests were used to compare relationships between case and variable clusters and extrinsic variables. This is a non-parametric statistic centred on the average rank of the attributes which is the same as the f-ratio (Belbin, 1993b).

Numerical taxonomy revealed the constructs and key variables which described differences and similarities between groups of people in the survey. As a result, clusters of people based on both shared similar values and separated by significant differences were explained by the analysis. This described clusters of shared intrinsic belief and value characteristics without the influence of extrinsic attribute descriptors such as age, gender, and farmer or non-farmer (Wardell-Johnson 2007).

3.9 Summary and Discussion

This chapter described the methodology chosen to collect the data for the research and justified the choice of methodology. The processes of the research were deeply

embedded with the discovery/exploratory approach. The research design encompassed a descriptive approach to determine peoples' attitudes and explore the influences and drivers of these attitudes.

The approach to the research design was directed by the contentious ambivalence that has characterised the climate change topic. The reality is that climate change is not a one dimensional problem, but rather a multiple of interwoven socio-cultural, ecological, political and economic issues contributing to what is in effect a "wicked problem" (Swedish Morphological Society, 2005–2011). Wicked problems are ambiguous, poorly defined and linked with strong political, professional and moral questions and concerns. They are stakeholder-dependent and there is frequently little agreement about what the problem is and how to bring the problem to any resolution. In many instances, new problems will emerge as a result of trying to apply a solution to one aspect of a wicked problem (Swedish Morphological Society, 2005–2011).

Cross sectoral research in a post disciplinary paradigm is an approach used to address the complexity of wicked problems. This approach explores the pathways to facilitate a cooperative multi-disciplinary approach to solve wicked problems. The interdependencies between humans, climate and environment and the conflicts and trade-offs represent a "wicked problem" mired in a somewhat disordered state. "Wicked problems" are characterised by disruptive elements that may obstruct how policy makers broach ethical issues. Conditions of engagement can be exacerbated by moral and epistemological issues (Anthony, 2011; Brown, Harris and Russell, 2010; Rittel and Webber, 1973). This dictated the need to extend the research beyond the reflective/interpretive analytical approach.

The vastness of Western Australia's agricultural regions and diversity in climate across these regions was also a major contributing factor to the research design. The objectives were to deliver a survey to a sufficient number of people spread over a vast area at a specific point in time in order to produce a statistically competent analysis. The design of the questionnaire was crucial to attaining these objectives. The questionnaire needed to contain enough variables to provide an optimum of information and be brief enough so people would be willing participate the survey and complete the questionnaire.

In addition, the decision to use two statistical analytical programs in the analysis process reflected the complexities and diversity of issues climate change presented the research. Use of the two analytical approaches also enabled the research to fulfil the intention to broaden the analysis. Numerical taxonomy offered the opportunity to explore beyond the boundaries of prior assumptions and discover underlying relationships between peoples' values, their social structures and intrinsic attitudes.

The exploratory part of the research, the Familiarisation study, began to reveal relationships between rural peoples' values/attitudes with their bio-physical, social environment. In the following chapters (Chapters four to nine) the results of the quantitative research will be described and discussed. Chapter Four will describe the demographic characteristics of the people who took part in the survey. Chapter Five examines participants' attitudes to climate change and their perception of risk/threat associated with climate change. These perceptions contributed to clustering of typological characteristics and values that are reported in Chapter Six. Chapter Seven explores attitudes to the role of governments in climate change and Chapter Eight examines information/knowledge sources valued by the total survey sample and the climate change value clusters described in Chapter Six.

Chapter 4: Demographics of Research Participants

4.1 Chapter Outline

The objectives of the research were to examine the attitudes of rural Western Australians concerning climate change, climate change science and governance and to explore what was contributing to the development of their attitudes.

The beginning of this chapter explains the approach taken in designing the survey in response to these complexities. The aim was to draw out information which enabled a capacity to explore determining characteristics and potential relationships between attitudes and any influences the attitudes were derived from (Section 4.2). Following on from this, participant response rates are reported (Section 4.3) and demographic characteristics of all participants in the research are described in Section 4.4. In addition, the demographic characteristics specific to farming participants are described in Section 4.4.1. The chapter concludes with a discussion of the participants' spatial and socio-cultural characteristics and the implications this had for the research (Section 4.5).

4.2 Survey design

The first section of the survey questionnaire was designed to gather information related to participants socio-cultural and geo-demographic characteristics. This was done so comparisons could be made these characteristics and participants responses to climate change, climate science and governance. Additional questions were used to measure participant's responses to climatic events and examine perceptions of climate change risk and responses to the risk. Participants' environmental values and attitudes to sustainability were also examined.

The survey questionnaire was structured around four sections that addressed specific elements that the literature and Familiarisation study had indicated to be contingent with the development of attitudes. The sections were organised in the following order:

1. Socio-demographic characteristics
2. Personal perceptions of climate change

3. Attitudes to climate change which included:
    - Perceptions of threat
    - Attitudes and responses to climate change threat
    - Opinions of science and perceptions of climate science credibility
    - Perceptions of governments' (State and Federal) climate response and implications for rural people
4. Climate change information and knowledge sources, which included personal sources (general media and internet), local social networks, industry and Landcare networks and expert (science and government) sources (See Appendix 5 for a copy of the full survey document).

The questions in the first section related to participants' socio-demographic characteristics were designed to gather information to determine if there were relationships between participants' socio-cultural and bio-physical environment and their conceptualisation of climate change (Covello and Johnson, 1987; Holloway, 1999).

The analysis also sought to determine if there were groups of participants with similar socio-demographic characteristics who shared similar attitudes to climate change, which were statistically different to other groups within the survey sample. This research objective aimed to identify attitudinal characteristics held in common among participants to provide an insight into the influences of attitudes to climate change among rural Western Australians. The practical applications of results of this research objective were to increase effectiveness of the climate change adaptation education/extension processes.

4.3 Response rates

A total of 417 surveys were collected during the survey period that ran from August 19 to November 30, 2008. The main data collection period took place during the field days with 114 surveys collected from the Dowerin event on the 27th–28th August, 91 were collected from the Newdegate event on the 3rd–4th September and 78 surveys were collected from the Mingenew Expo on the 18th–19th September (Chapter 3, Section 3.5.2).

There was an overall refusal rate of 17% during the personal interview phase undertaken at the field day events. The highest rate of refusals was recorded during the Dowerin event with 23% of people who were approached to participate in the survey declining to take part. In contrast, just eight percent of people approached during the Newdegate event and 16% at the Mingenew field days declined to participate.

A further 95 questionnaires were distributed throughout the field day events as survey interviews were being conducted. Overall, 56% of surveys were returned. Again response rates varied markedly across the three field days. Just 20% of surveys distributed during the Mingenew field days were returned, whereas 50% from the Dowerin and 78% from Newdegate events were returned.

During the Perth Royal Show 15 surveys were collected via personal contact with three people (17%) declining to be interviewed. Another 35 surveys were distributed to be completed by participants and returned by mail. Of these surveys, 23 were returned, representing a 66% response rate.

Fifty surveys were distributed during the Waroona Agricultural Show and the Katanning Pasture Field day. There was only a 14% response rate from the Katanning event and 30% from the Waroona Show. Of the surveys distributed during the Muresk Open Day, 22 were returned. However, response rates could not be calculated as people were not directly approached to participate in the survey.

The total response rate for the personal contact phase of the survey was 83%. Of the directly distributed surveys that response rates could be calculated for, 41% were returned. Although this is well below the 60% response rate achieved in Wardell-Johnson's (2007) research, it is comparable to the 48% response to a community and environmental sustainability survey conducted in the Northern Agricultural Region (NAR) (Howard, 2008).

Although it was hoped to have had around 500 surveys completed during the data collection period, the final total of 411 was considered a sufficient representation of WA's rural communities. In total 417 surveys were collected but six surveys were excluded from the analysis due to incorrect entry or deliberate miss-entry.

4.4 Demographic characteristics and sample validation

Demographic characteristics of survey participants were collected to enable testing of the samples' validity in comparison to the Australian Bureau of Statistics (ABS) WA Rural Regions/WA Agricultural, Forestry and Mining census. It was anticipated that participants' demographic details would be different to the Western Australian rural population as described by ABS census data. The majority of survey participants were males (70%) (Table 4.1).

Table 4.1 Gender of Participants

Gender	Freq.	Percent. %	ABS percent. %
Male	287	70%	52%
Female	115	28%	48%
Missing	9	2%	2.0 %
Total	411	100%	100%

Although there appeared to be only slightly more males than females attending the events at which the surveys were conducted, the representation of females (28%) in the survey was much lower than the WA rural female population (48%) (ABS, 2005), but comparable to that of females working in agriculture, forestry and fishing (30%) (Department of Training and Workforce Development, 2011).

The low percentage of female responses during the survey could be attributed to several factors that precluded opportunities to acquire a more equal number of responses between genders. Generally, interviewers found females attending the events were in the company of male partners, and/or their children or male family members. Interviewers found that in most of these situations when potential female participants were approached to take part in the survey they would defer and direct the interviewer to the male. Alternatively, interviewers were restricted in approaching women who were attending the event with young children as it was difficult for them to complete the survey and maintain attention on the children in their care.

Although the imbalance between genders and the effect it may have had on some results was somewhat of a concern, there was a reticence to alter the sampling

approach. This could have been achieved by introducing gender purposive sampling to ensure that rural female representation as a group of identity and interest was deliberated targeted (Wardell-Johnson, 2007) after the survey had commenced. Although female representation was important to the research, it was felt that altering the sampling method once the survey process had commenced would mean representativeness of females in areas already surveyed would be less than the areas to be surveyed. As such this may have biased some results. The inability of this research to facilitate a more comprehensive representation of rural females' attitudes to climate change identified the need for future research in this area. Although the sample did not reflect representation of rural females compared to ABS (2005) information, results did not indicate significant differences between the genders.

In average age of participants was 40 with dominant age category being the 40-64 age group comprising 53% of participants (Table 4.2). The 26-39 year olds were the next largest age group represented with 22% of participants. ABS statistics indicated the median age in WA rural areas was 39 years and the median age of WA farmers was 51 (ABS, 2005). This suggests the ages of participants were reasonably representative of the broader WA rural population and farming community.

Table 4.2 Age of participants

Age category	Frequency	Percent. %
18-25	59	14%
26-39	92	22%
40-64	217	53%
65-79	39	10%
80+	0	0%
Missing	4	1.0%
Total	411	100%

Three quarters (75%) of participants indicated that they 'owned, managed, or contributed to farming operations' in some capacity (Table 4.3). This group was over represented in the survey sample when compared to ABS (2006) statistics, which indicated people directly involved in farming comprised 15% of Western Australia's rural regional population.

Table 4.3 Own, manage or contribute to farming operations

Contribute to farming	Frequency	Percent. %
Yes	308	75%
No	95	23%
Missing	8	2%
Total	411	100%

The over-representation of participants who owned, managed or contributed to farming in the survey could be attributed to the nature of the field days, which were highly orientated to people directly involved in farming and the agricultural industry. In this regard, the research results are more appropriately generalized to the rural farming community and not necessarily the broader rural community as a whole.

The percentage of participants who owned or managed farms (73%) were higher than expected for the farming community (60%) (Department of Training and Workforce Development, 2011) (Table 4.4). The remaining 17% owned, managed or worked in closely allied industries, such as transport, fuel and oil supply, agricultural consultancy, machinery servicing and agriculture contracting.

Table 4.4 Type of contribution to farming

Contribute to farming	Frequency	Percent. %
Own/manage a farm	225	73%
Farm employee	30	10%
Allied farm industry	53	17%
Total	308	100%

A further 29% of participants indicated that they owned a business other than farming in a rural community. It was difficult to disseminate various rural non-agriculture businesses from agri-businesses in the ABS (2011) data. Nevertheless, the data available indicated there were more non-agriculture businesses than agribusiness in WA rural areas. This suggested that non-farming/agriculture rural business owners were under represented in the survey population.

Of participants who owned a business in a rural community, 80% owned agribusinesses such as: agricultural machinery dealerships/services; transport companies; stock agencies; contracting (shearing, fencing, and fertiliser spreading

and seeding contract businesses); farm shed/building construction; and farm fuel and oil services. Fewer participants owned non- farming or agribusinesses (20%) such as: school bus runs; delicatessens; private dwelling construction; real estate and investment consultancy services (Table 45).

Table 4.5 Business ownership and type (non-farming)

Business type	No. of businesses	Percent. %
Agribusiness	78	80%
Non-agribusiness	20	20%
Total	98	100%

Half (50%) of the businesses were owned by farmers, of which 46% were owners of agribusinesses while 4% owned non-agricultural businesses. Within the group of business owners, ownership of agribusinesses was higher among farmers (58%) than non-farmers (42%), while ownership of non-agribusinesses was higher among non-farmers (80%) than farmers (20%).

ABS (2011) data for business entry and exit June 2007 to June 2009 showed there were 13,661 agriculture businesses (mostly farm businesses) in the survey area (The Pilbara and Kimberley data was excluded from these figures as was the unknown data) (Table 4.6). There were 12 business types that could be reasonably be described as non-agricultural and accounted for 21,479 businesses in the research area. In addition, there were a further seven business types which could either function as an agri-business or non agri-business.

Table 4.6 Rural Business Industry Division

ABS Business type	No. of businesses	Percent. %
Agribusiness – (mostly farm businesses)	13661	28
Non-agricultural including : Mining Electricity, Gas, Water and Waste Service Construction Accommodation and Food Services Information Media and Telecommunications, Rental, Hiring and Real Estate Services, Administrative and Support Services, Public Administration and Safety, Health Care and Social Assistance, Arts and Recreation Services, Other Services &Not Classified 1	21479	44

Undetermined business type (could either service agriculture or general rural population) Manufacturing Wholesale Trade Retail Trade Transport, Postal and Warehousing Professional, Scientific and Technical Services Education and Training Financial and Insurance Services	13902	28
Total	49042	100%

Ownership of non-farming rural businesses was used to examine if diversity in farmers' economic structures (non-farming businesses) had contributed to perceptions of economic resilience in the face of climate variability. If this was the case, perceived resilience to climate variability could contribute to farmers' perceptions of climate change threat. The value of economic diversity through income and asset sources independent of the farm business was recognised as a potential indicator for future climate change resilience (Nelson, Kokic, Elliston and King, 2005).

Participants were then asked what type of work they mostly did. This inquiry had two intentions. The first was essentially an extension of the previous question which sought information to compare responses of farming participants with access to alternative sources of income compared to those who relied on income from the farm which previous research had indicated as a resilience capacity (Nelson et al., 2005). The second intention of the question was to provide information so responses could be compared between occupation categories. In addition, international research had suggested peoples' occupation, employment skill set and income potential were contributory demographic indicators within attitudinal climate change typologies (Maibach et al., 2009).

Participants were grouped into employment and occupational categories as described and used by the ABS (2006a) (Table 4.7). The largest occupation/employment group represented in the survey were managerial and farming at 45% of participants. However, when compared to ABS (2006a) occupation statistics (62%) this group was under represented by approximately 15% in the survey sample.

Table 4.7 Type of work mostly done by respondents

Occupation	Freq.	Percent. %	ABS %
Managerial/Farming	160	45%	62%
Professional	35	10%	3%
Administration/sales/service	80	23%	5%
Trades/skilled labourer/technician	44	12%	10%
Labourer-unskilled	24	7%	20%
Missing	10	3%	-
Total	333	100%	100%

In terms of the research, the smaller representation of farm and business managers had the potential to reduce the validity of results in regard to groups' attitudes to climate change. Although there was an over-representation in the survey sample of owners and managers of farms they were of high interest to the research as were participants managing farm businesses or allied non-farm businesses. As decision makers, their attitudes to climate change may have influenced their prioritisation of climate change threat as an economic risk factor for sustainability of their businesses. It had been shown that farmers viewed increasing productivity and profitability as important to economic sustainability and did not consider climate change a problem as it was assumed there would be time to adapt to changes in the climate (Fleming and Vanclay, 2009).

There was also a higher representation of professionals (10%) along with administration and sales and service (23%) occupations in the survey compared to the ABS statistics (2006a) (Table 5.7). ABS (2006a) information shows that professionals made up only 3% of occupations in the primary industry sector, with administration/sales and services accounting for just 5%. In addition, unskilled labourers were under represented in the survey (7%) when results were compared to ABS (2006a) statistics for the Agricultural, Fisheries and Mining sector.

People not in the paid workforce such as those who were retired, homemakers or secondary and tertiary students were under represented in the survey when compared to ABS (2001a) statistics (Table 4.8). Despite 10% of participants in the survey being between 65 and 79 years old, a figure comparable to ABS (2005) retirement statistic of 12% for WA, only 1% of participants indicated that they had retired. ABS

(2006a) statistics show people in WA's Agriculture, Forestry and Fishing industries tended to retire later than those in other occupations.

Table 4.8 People not in the paid workforce

Unpaid occupation	Freq.	Percent. %	ABS %
Retired / pensioner	4	1.1%	12%
Homemaker	2	0.6%	1.3%
Student	6	1.8%	10.9%
Total	12	2.5%	24.1%

The Australian Bureau of Statistics Demographic National Action Plan for Salinity and Water Quality Regions (NAPSWQ) (ABS 2006) was used to compare the geo-demographics profile of the surveyed sample (Table 4.9). After aligning Local Statistical Division population statistics (ABS, 2005) with the geographic divisions of the NAPSWQ, comparisons with ABS (2006) data showed the South West Region with 51% of survey participants was under represented, whereas Avon with approximately 19% of survey participants and the Northern Agricultural Region (NAR) with 16% was over represented in the survey. The South coastal response of 11% was representative of the population in the region. Although over a third (35%) of participants were from the Avon NAPSWQ region, representation of the other NAPSWQ regions identified as being vulnerable to climate change (Hennessey et al., 2007), including the Perth metropolitan region, did not fall under 11%.

Table 4.9 Total survey population by NAP Regions

Survey population	Freq.	Percentage %
Southwest	62	15%
Avon	145	35%
South Coast	47	11%
NAR	80	20%
Metro	45	11%
Other	11	3%
Missing	21	5%
Total	411	100%

Participants were then asked how long they had lived in the region. The research purpose of this question was to compare responses of groups of participants who had

lived in locations for differing periods of time. This was to explore the influences of sense of place and sense of identity, which can be derived from the length of time a person has lived in an area (Stedman, 2003), had on participants interpretations of what changes in the climate implied. Stedman (2003) suggested there were relationships between peoples' perceptions and recognition of change in their environment and the length of time they had lived in the area.

The average time participants had lived in an area was 33 years (Table 4.10). A third (34%) of participants had lived in an area less than 10 years and 27% had lived in an area for 21–40 years while 22% had lived in area for longer than 40 years.

Table 4.10 Length of time lived in area

Time category: years	Freq.	Percent. %
<5	75	18.2%
5-10	64	15.6%
11-20	69	16.8%
21-30	67	16.3%
31-40	44	10.7%
41-50	40	9.7%
51+	48	11.8%
Missing	4	1%
Total	411	100%

4.4.1 Farmer subset demographic characteristics and sample validation

Participants who indicated that they contributed to farming were invited to complete a separate series of questions to ascertain characteristics of their involvement in farming. Questions included: the length of time participants had been involved in farming; the length of time their family had been involved in farming; what was the farm's main business enterprise; location and size of the farm or farms; and if they were members of farmer/ industry groups and catchment /Landcare groups.

The average time participants had been involved in farming was 35 years. Over a third (36%) of participants had been involved in farming for 20 years or less, while 33% had been for between 21 and 40 years and 31% had been farming for more than 41 years (Table 4.11). (The time involved in farming category of 'one to ten years' represents combined results of participants who had been involved in farming for

less than five years and those who had been involved in farming for between five to ten years).

Table 4.11 Time involved in farming

Time category: years	Freq.	Percent. %
1-10	40	15.7%
11-20	52	20.4%
21-30	45	17.6%
31-40	40	15.7%
41-50	36	14.1%
51+	42	16.5%
Total	255	100%

Compared to studies of the same population of interest, ABS data (2006) indicated participants with one to ten years of involvement in farming (16%) were relatively over represented in the survey compared to the overall WA farming population (9%) (Table 4.11). Other research showed participants' farming experience in this research was greater than found in rural WA surveys by Storer (2010) (average 16 years) and Langley et al. (2007) (average 22 years).

Most of the farming participants had an extensive family history in farming among. The average was forty two years (Table 4.12). Three quarters (75%) of participants had more than 40 years of family involvement in farming while those who recorded farming as an occupation had more than 50 years of family involvement in farming. (Family time involved in farming category 'one to ten years' represents combined results of participants whose family had been involved in farming for less than five years and for between five to ten years).

Table 4.12 Family involvement in farming

Time category: Years	Freq.	Percent. %
1-10	12	4.8%
11-20	11	4.3%
21-30	11	4.3%
31-40	15	5.9%
41-50	22	8.6%
51 +	170	66.7%
Missing	14	5.5%
Total	411	100%

Research indicates the prevalence of inherited succession within WA farming families with the occurrence of a high rate of entry to 'new land' farms during the 1960s (Archer and Catt, 1998) suggested the long term family history in farming in the survey population was a reasonable representation of WA's farming sector.

Compared to ABS (2007) statistics, most farm business enterprises were under represented in the survey sample. The exception was mixed grain/livestock businesses (57%), which were over represented when compared to ABS (2007) statistics of 18% (Table 4.13).

Table 4.13 Farm's main business enterprise

Main business	Freq.	Percent. %	ABS %
Only grain	21	8%	16%
Beef	23	9%	21%
Sheep/meat/wool	22	9%	13%
Mixed grain/livestock	145	57%	18%
Other (diary/horticulture/viticulture)	30	12%	32%
Missing	14	5%	-
Total	255	100%	100%

The disproportionate representation of mixed grain/livestock businesses may have been a result of specific interest in the field days which were devoted mainly to broadacre activities related to grain and livestock. Diary, viticulture, horticulture and alternative livestock enterprises' representation were in the main limited to the Perth Royal Show and Waroona Show locations which catered for those enterprise types.

There were 262 farm locations spread across the four National Action Plan for Salinity and Water Quality Regions (NAPSWQ) of the South West, Avon, South Coastal and Northern Agricultural Region (ABS, 2008) (Table 4.14). The Australian Government's NAPSWQ were used to define the regions of farm locations to allow a more generalised alignment of the agricultural regions to conform to both agricultural and environmental systems (NAPSWQ, 2008). The percentage of farms from the Avon (42%) and NAR (21%) were over represented in the survey when compared to ABS (2008) data while the number of South coast and South West farms were under represented. However, this indicated the sampled population reflected the land use and agricultural practices of interest to the research.

Table 4.14 Farm locations – NAPSWQ Regions

NAP Regions	Freq.	Percent. %	ABS NAPSWQR %
Southwest	50	19%	26%
Avon	111	42%	34%
South Coast	46	18%	26%
NAR	55	21%	14%
Total	262	100%	100%

Farm size in conjunction with farming systems and opportunities derived from regional diversity had been identified as contributory factors to the potential for adaptive capacity (Reidsma and Ewert, 2008). Additionally it was thought that large farm businesses could enhance adaptive opportunities or limit climate change impacts due to spatial diversity (Kingwell, 2006).

The size of landholdings in the survey varied from 1–44 Ha (9%) out to greater than 10,000 Ha (3%) (Table 4.15). The median area of farms in the survey was 2001–4000 Ha (22%) with 1001–2000 Ha (16%) and 4001–6000 Ha (14%) representing the next highest percentage of farm areas.

Table 4.15 Farm area – Ha

Hectares	Freq.	Percent. %
1-44	22	8.6%
45-500	44	16.1%
501-1000	17	6.7%
1001-2000	42	16.5%
2001-4000	56	22%
4001-6000	35	13.7%
6001-8000	8	3.1%
8001-10000	8	3.1%
10001+	7	2.9%
Missing	19	7.5%
Total	236	100%

The average area of 2001–4000 hectares of farm in the survey and the range in the size of farms was fairly comparable to the average size of farms in WA's agricultural regions. The average size of landholdings in the South West region at 218 Ha was comparable to ABS (2008) statistics of 244 Ha (Table 5.15). The average size of landholding in the other three regions was larger than ABS (2008) statistics. Area of Avon landholdings was 3504 Ha compared to ABS (2008) statistics of 2020 Ha,

with Southern Coastal landholdings of 3274 Ha more than double ABS (2008) data of 1414 Ha. Average NAR landholding area was 5825 Ha compared to ABS (2008) statistics of 3348 Ha.

Over half (55%) of farming participants were members of farmers' grower groups and/or industry organisations (Table 4.16).

Table 4.16 Members of Farmer Grower Groups / Industry Organisations

Members of grower/ industry groups	Freq.	Percent. %
Own, manage or work on farms-Yes	139	54.5%
Own, manage or work on farms-No	116	45.5%
Total	255	100%

It was not possible to compare results with ABS or ABARE statistics as neither organisation had the relevant data. Subsequent discussions with the Senior Project Manager of the Grower Group Alliance (GGA) revealed that overall individual farmer membership of the various industry groups was at the time not accurately recorded (Hall, Chief projects officer, pers com, 2009). Membership of the Grower Group Alliance was through the independent Grower Groups and not through individual farmers who were members of those groups. However, GGA estimations that over 50% of broadacre farmers were members of industry groups suggested the survey results were comparable to WA's broadacre farming population (Table 4.16).

Responses showed 44% of farming participants were members of Catchments or Landcare groups (Table 4.17).

Table 4.17 Farming members of Catchments or Landcare Groups

Members of Catchments / Land Care	Frequency	Percentage %
Yes	112	44.4%
No	140	55.6%
Total	252	100%

This indicated membership of Catchments and Landcare groups in the survey was representative of the farming population when compared to ABARE statistics for WA (47%) (Hodges and Goesch, 2006). In addition 75% of farming participants were members of both industry/grower groups and Landcare/Catchments groups.

4.5 Discussion

The demographic characteristics of participants suggested the research had captured a sample population that reflected the spatial, climatic and farming systems' diversity of the Western Australian agricultural industry and rural communities. However, it was disappointing not to have achieved a higher female response rate than 28% given that females constituted 48% of the WA rural population (ABS, 2005).

Importantly, there was adequate representation of farmers and the broader rural communities across the 'Rainfall Zones' of most of the agricultural regions (with the exception of the Pilbara and Kimberley) (Stephens and Lyons, 1998). Within each of the NAPSWQ regions 'Rainfall Zones' ranged from 'Low Rainfall Zones' through to 'Medium' and 'High' rainfall zones (Appendix six). This allowed the research to compare and explore differences in attitudes between participants in the major NAPSWQ regions and investigate if there were differences between participants within the regions.

Additionally the range of farm business enterprises represented in the research, although heavily favouring 'mixed grain/livestock' (57 %), still retained a measure of diversity of farm business enterprises in WA's agricultural regions. Again this allowed the research to see if there were differences in attitudes to climate change between farmers who operated within different farming systems and main enterprises.

Similarly the representation of different sized farms enabled the research to explore and compare climate change attitudes between farmers who had smaller than average landholdings with those who had average and larger than average landholdings.

The representation of non-farming participants in the survey enabled comparisons to be made between farmers and non-farmers' attitudes to climate change and perceived changes in the climate. In addition the research was able to compare non-farmers' attitudes to science and governance attitudes with farmers.

These characteristics of the sample population in addition to the time lived and farmed in area, allowed the research to examine participants' intrinsic attitudes to

climate change in more depth. This meant the research could explore broad rural socio-cultural concepts of climate change and associated topics, and also study in more detail concepts within farming and rural community culture which could be used to develop rural climate change typologies.

This more in-depth analytical approach begins in Chapter Five where results are described both in relation to the overall survey population and differences between and within groups of participants.

Chapter 5: Climate Change; Questions of Awareness and Threat

5.1 Chapter Outline

Analyses of participants' responses showed there were several separate but interrelated stories emerging from the research. Analyses of the survey sample described in Chapter four indicated the presence of two core groups of participants in the survey; farmers and non-farmers, with a small sub-set of agribusiness participants who also felt that they directly: *"…contributed to farming operations in any capacity"*. This chapter charts the emerging stories through descriptions of participant responses to: climate change (Section 5.2); climate change threat (Section 5.3); experience and knowledge of local climate (Section 5.4) and the validity of climate change science knowledge and information (Section 5.5).

5.2 Climate change attitudes and perceptions

The research initially sought to establish a base line of responses to climate change in the context of WA agricultural regions which would involve a larger number of participants and a greater spatial range than the eastern states' studies undertaken by Milne et al. (2008) and Fleming and Vanclay (2009a).

5.2.1 Is climate change happening; is it happening here; and is it natural?

Participant responses indicated a quarter (25%) were uncertain or somewhat uncertain if climate change was (18%) or was not (5%) occurring (Figure 5.1).

- 'Climate change is occurring':
  - 36% confidently agreed (16% strongly agreed/20% agreed)
  - 13% confidently disagreed (8% strongly disagreed/5% disagreed)

Most participants were sure their local area would be affected by climate change although 19% remained uncertain (Figure 5.1).

- 'Climate change is occurring but will not occur in my local region':
  - 4% confidently agreed (2% strongly agreed/2% agreed)
  - 59% confidently disagreed (38% strongly disagreed/21% disagreed)

The issue of climate change being either natural or the result of greenhouse emissions caused the most uncertainty amongst participants (Figure 5.1). Over a quarter (28%) were uncertain if climate changes were natural or not, while 14% were somewhat uncertain if it was natural and 12% if it was:

- 'Climate change is a natural climatic cycle and not influenced by greenhouse emissions':
  - 21% confidently agreed (9% strongly agreed/12% agreed)
  - 24% confidently disagreed (15% strongly disagreed/9% disagreed)

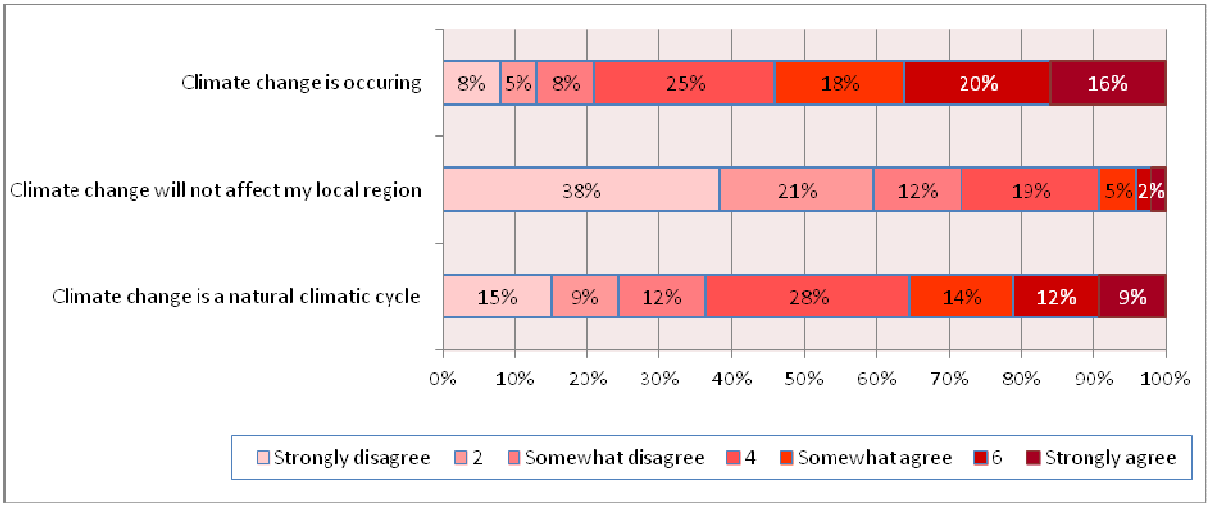

Figure 5.1 Climate change is occurring
n=410-411

Some participants expressed strong views in response to the statement: 'Climate change is occurring'. One farm/agribusiness participant commented:

> *"Anyone who doesn't think climate change is happening is either delusional or illiterate."*

Another farm/agribusiness participant validated their reasons for believing climate change was not occurring with:

> *"I know climate change is not happening and I have the rainfall records to prove it. They go back 90 years and they prove that climate change isn't happening. The average rainfall for the farm hasn't altered in 90 years"*

A non-farming participant who disagreed that climate change was a natural climatic cycle was succinct in their views:

> *"Of course it's [climate change] not natural. It's us, humans, polluting the atmosphere, cutting down the rainforests. Just worried about making and spending money on things we want but don't need."*

In contrast, a farm/agribusiness participant who believed climate change was natural observed:

> *"Yeah well it might have got less in the last 40 years but that's just part of the cycle. I've got a retired mate … driving around Australia for the last 3 years … cutting old trees down and looking at the growth rings. He was telling me … growth rings show … a 40 year cycle. The first 20 years … get dryer. … the next 20 years … gets wetter then it begins the 40 year wet cycle. In the wet cycle it …gets wetter over 20 years then begins to dry in the last 20 years of the cycle. So you see we are on the last year (2008) … the 40 year dry cycle and now it's going to get wetter. Let's see the scientists work out climate change then."*

Responses indicated a divergence of views concerning the occurrence of climate change, it being a natural climatic cycle and not influenced by greenhouse emissions. In some aspects these responses were similar to results derived from the Murray Darling Basin (MDB) (N:68) study of farming communities where 36% of participants believed climate change was occurring, 24% were not absolutely sure, 15% did not know and 11% did not believe climate change was occurring (Milne et al., 2008). Although there was some differences between these responses and a Tasmanian study of farming communities (N: 62) where 77% of farmers thought climate change was occurring, there were similarities in responses to climate change being caused by human activities: (19%) uncertainty of what were the causes (34%) (Fleming and Vanclay, 2009a). These results indicated that farming communities across Australia, although involved in different farming systems, shared similar attitudes to climate change.

However, other research had indicated that an awareness of climate change among both urban and farming communities did not necessarily translate into a perception of threat (Bord et al., 1998; EORG, 2002; Fleming and Vanclay, 2009a; Holloway, 1999; Gbetibouo, 2008). Studies propose perceptions of a need to adopt new behaviours and/or technologies are dependent on awareness of a need or problem which entails a threat or risk that requires an adoptive, or in the case of climate change, adaptive responses (Lindner, 1987; Pannell et al., 2006; Rogers, 2003).

Earlier research had shown that although urban and farming communities acknowledged climate change was occurring and was a concern, there was a tendency to rate other issues as more important (Anable et al., 2006; Dunlap and Saad, 2001; Patt and Schroter, 2008). Examining participant's perceptions of climate change threat/risk was the next process of this research.

5.3 Perceptions of climate change threat

The aim was to determine if participants perceived climate change as a major threat to the future of WA rural communities and farms/agribusinesses (Figure 5.2). Although many participants did view climate change as threat to their communities, 17% were unsure.

- 'Climate change is a major threat to the future of rural communities'
  - 43% confidently agreed (22% strongly agreed/21% agreed)
  - 17% confidently disagreed (10% strongly disagreed/7% disagreed)

Fewer farm/agribusiness participants thought climate change was a threat to their farm/ businesses, but again 17% were uncertain.

- 'Climate change is a major threat to the future of farms/agribusinesses'
  - 36% confidently agreed (14% strongly agreed/19% agreed)
  - 20% confidently disagreed (12% strongly disagreed/8% disagreed)

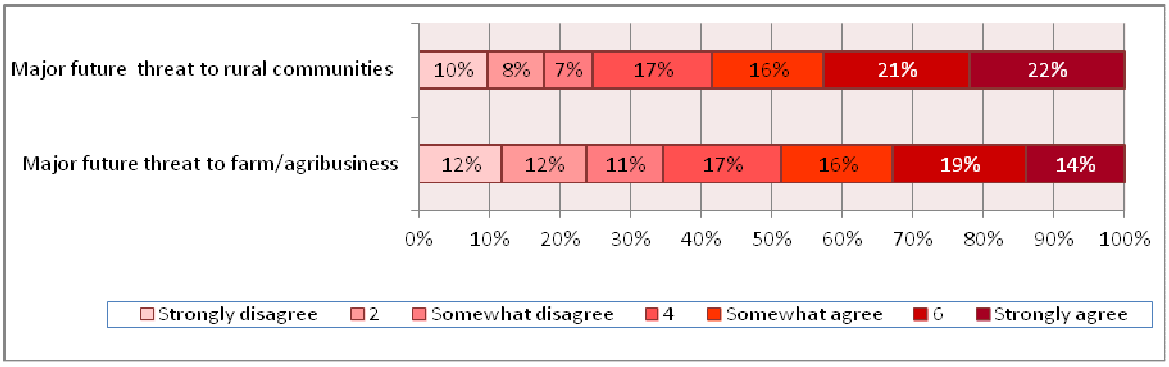

Figure 5.2 Climate change threat
n= 346-404

Of note was the higher perception of climate change being a major threat to the future of rural communities compared to climate change being a major threat to the future of farms/businesses. This suggests a concurrence with Covello and Johnson's (1987) proposal that threats may be conceptualised within accepted parameters of socio-cultural frameworks of experience and knowledge. For instance, farmers who are directly affected by the vagaries of the climate have an intrinsic familiarity with the derived risk and benefit and which they have to a large extent been able to accommodate in their management programs. Therefore it could be that farmers believe they can manage the future climate threat/risk to their businesses. On the other hand climate threat to communities may be perceived to be outside the intrinsic knowledge domain of farmers and non-farmers and be seen as a problem that needs policy support and intervention.

Of note was the deviation between participants' attitudes to climate change occurring and their perceptions of climate change threat. Although only 36% believed climate change was occurring and 24% did not think it was natural, 43% thought climate change was a major threat to the future of rural communities. There were also some differences between the perceived climate change threat to communities (43%) and farms/businesses (33%). The questions were: what was contributing to more participants perceiving a threat to rural communities than accepted climate change was occurring and what was contributing to differences between perceptions of threat to communities and farms/businesses? Part of the answer to the latter question was reflected in the priority of importance attributed to climate change concerning economic sustainability of farms/business compared to other economic issues.

5.3.1 Farm/agribusiness economic considerations

Farm/agribusiness participants were asked to rate the importance of three short-term cost imperatives along with two medium to long-term economic and management issues and long-term environmental and climate change considerations to the sustainability of their farms/businesses (Figure 5.3).

- Most farm/agribusiness participants highly rated the importance of short-term cost imperatives of fuel, fertiliser and chemical prices:
- Fuel prices; 71%

- Fertiliser prices; 75%
- Chemical prices; 67%

Approximately half of farm/agribusiness participants highly rated the importance of medium to long-term concerns of:

- Interest rates; 53%
- Labour shortages; 49%

However, responses varied to long-term environmental and climate change concerns:

- environmental sustainability; 49%
- Climate change; 33%

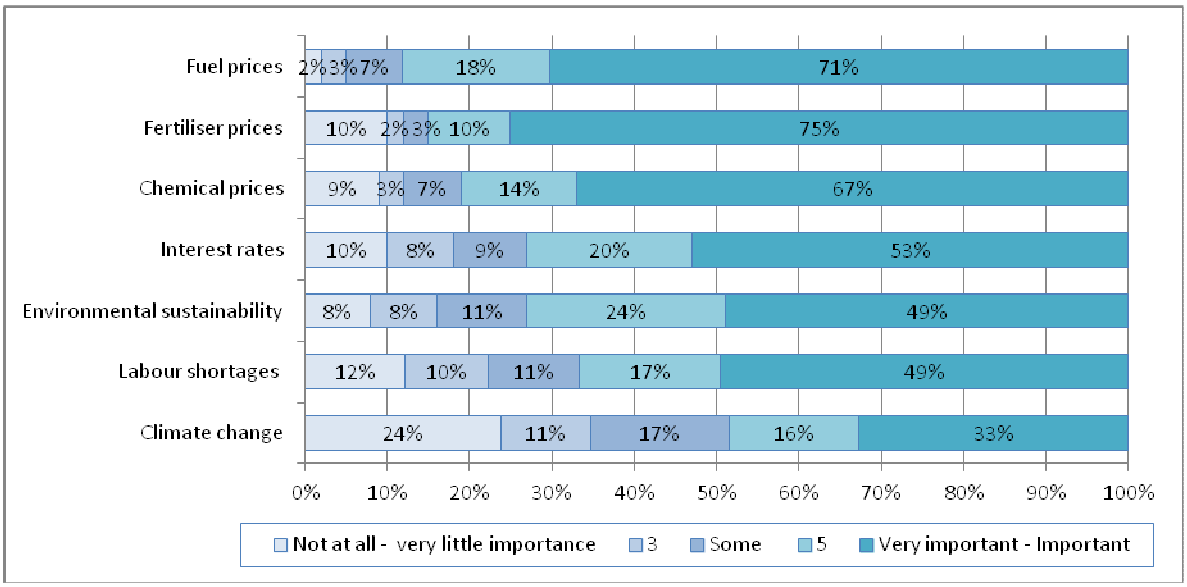

Figure 5.3 Farms/agribusinesses priorities
n= 321-346 (Not at all/very little importance and Very important/important values were collapsed to facilitate presentation of results)

Short term cost imperatives of prices for fuel, fertiliser and chemicals were rated as the three most important factors in business economic sustainability (Figure 5.4), with climate change rated as least important.

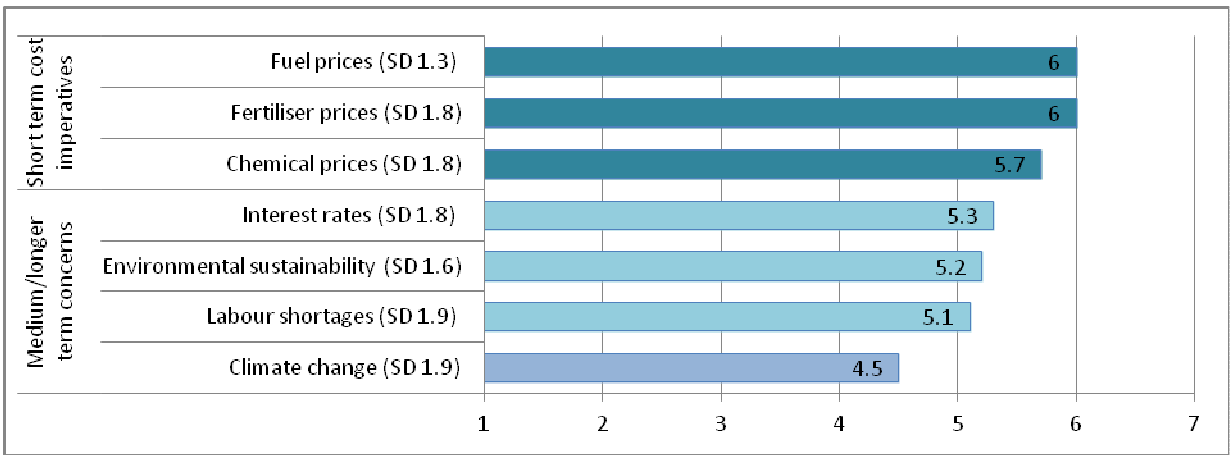

Figure 5.4 Important impacts on business economic sustainability
Scale of 1=not at all important-7=very important
n=321-346

The low priority ranking attributed to climate change was similar to results from other research that showed although the public was concerned about climate change, there were other issues they considered more important (Anable et al., 2006; Dunlap and Saad, 2001; Langford, 2002; Maibach et al., 2009). Research has shown the difference between concern and priority can influence willingness to respond to climate change (Maibach et al., 2009). This research examined whether the divergence between awareness and engagement was also present among rural Western Australians.

5.3.2 Climate change: Concern or engagement?

A study by Langford (2002) indicated four core perceptions in responses to climate change. These ranged from: no need to respond; doubt if there was a need; willingness to respond but unsure how to and willingness to respond and doing so. Evaluation in this research of participants' perceptions that climate change was a problem that needed to be engaged illustrated a diverse range of responses (Figure 5.5).

- 'There is no need to respond to climate change':
    - 52% confidently disagreed (34% strongly disagreed/18% disagreed)

- 'I will wait and see if there is need to respond to climate change':

- 45% confidently disagreed (29% strongly disagreed/16% disagreed)

- 'There is a need to respond to climate change and I am responding':
  - 30% confidently agreed (11% strongly agreed/19% agreed)

- 'There is a need to respond to climate change but I am not sure what to do':
  - 27% confidently agreed (9% strongly agreed/18% agreed)

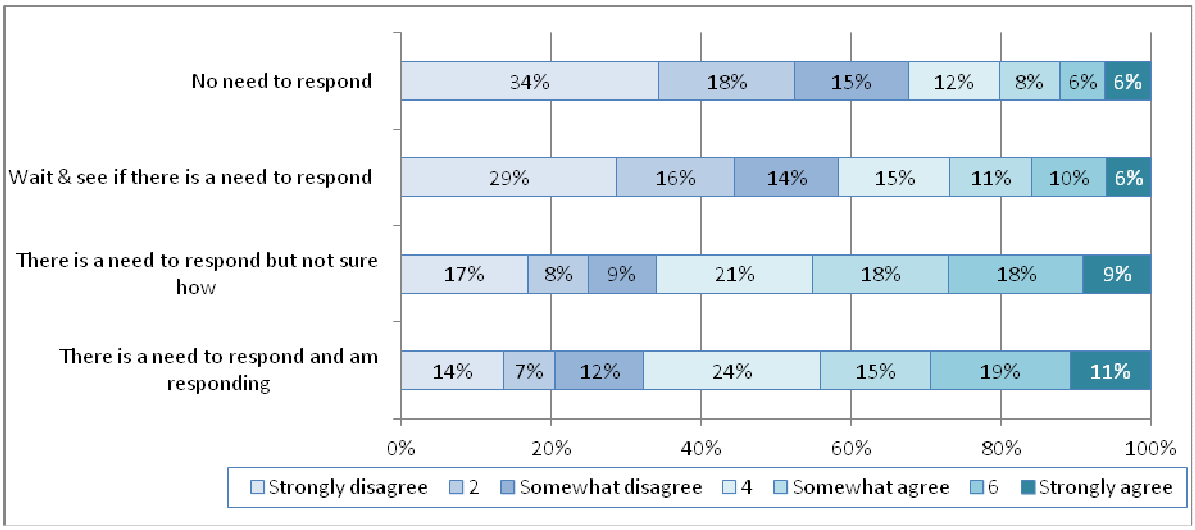

Figure 5.5 Responding to climate change
n=399-408

While there was a relatively high perception of climate change threat to the future of rural communities, many participants were unsure if they were responding to climate change or wanted to respond to climate change but did not know how to (Figure 5.6). Yet despite this uncertainty, most participants were not inclined to wait and see if there was a need to respond or think there was no need to respond to climate change.

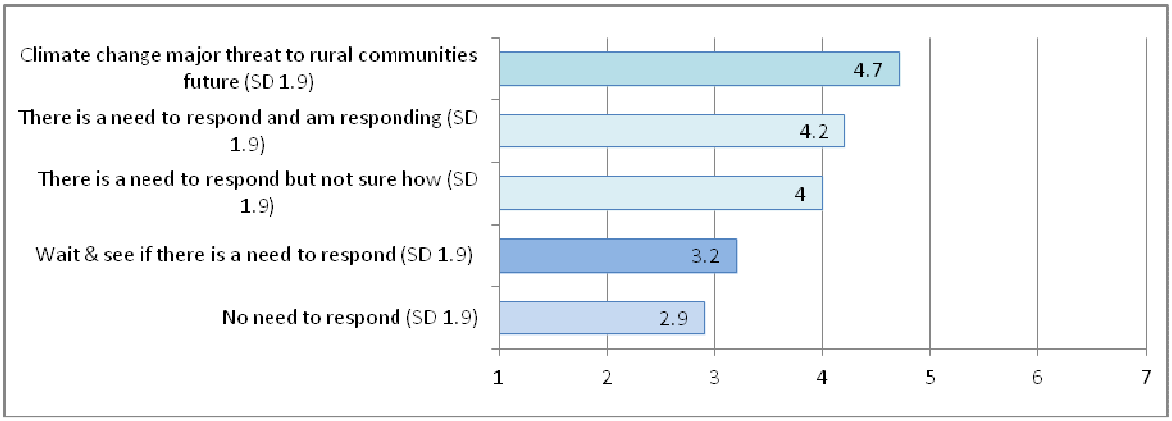

Figure 5.6 Engaging climate change
Scale: 1=strongly disagree-7=strongly agree
n=399-408

These results indicate that although most participants did not agree there was no need to respond to climate change the willingness to respond was dispersed between knowing how to and not knowing how to. However, the unwillingness to believe there was no need to respond or wait and see if there was a need suggested an underlying concern with climate change threat.

The results again demonstrated a similarity in responses between farming communities on opposite sides of the continent with 30% of participants in this research indicating they were responding to climate change compared to 26% in the Tasmanian study of farmers (Fleming and Vanclay, 2009a). However, the divergence of responses to climate change and climate change threat suggested there were other contributing influences. It had been proposed that risk is conceptualised within a socio-cultural context (Covello and Johnson, 1987) and that response to a threat were based on perceptions of whether a threat emanated from a natural or human source (Finucane, 2000). Finucane (2000) suggested people would be less inclined to take preventative actions if a threat was perceived to be derived from natural activity than if the threat was caused by human activity.

5.4 Observations of changes in local climate

To evaluate if participants were conceptualising climate change and climate threat within a socio-cultural framework of experience and knowledge, they were asked if they had noticed any changes in climate over the previous 10 years (Figure 5.7).

- Most participants had noticed: 'Decreased rainfall':
    - 24% a great deal (14% 'a lot'/10% 'quite a lot')
    - 29% 'quite a bit'
- Equally most participants had noticed: 'Increased variability in seasons'
    - 26% a great deal (14% 'a lot'/12% 'quite a lot')
    - 33% 'quite a bit'
- Slightly fewer participants had noticed: 'More extreme weather events (such as droughts, and severe storms)

- 20% a great deal (11% 'a lot'/9% 'quite a lot')
- 21% 'quite a bit'

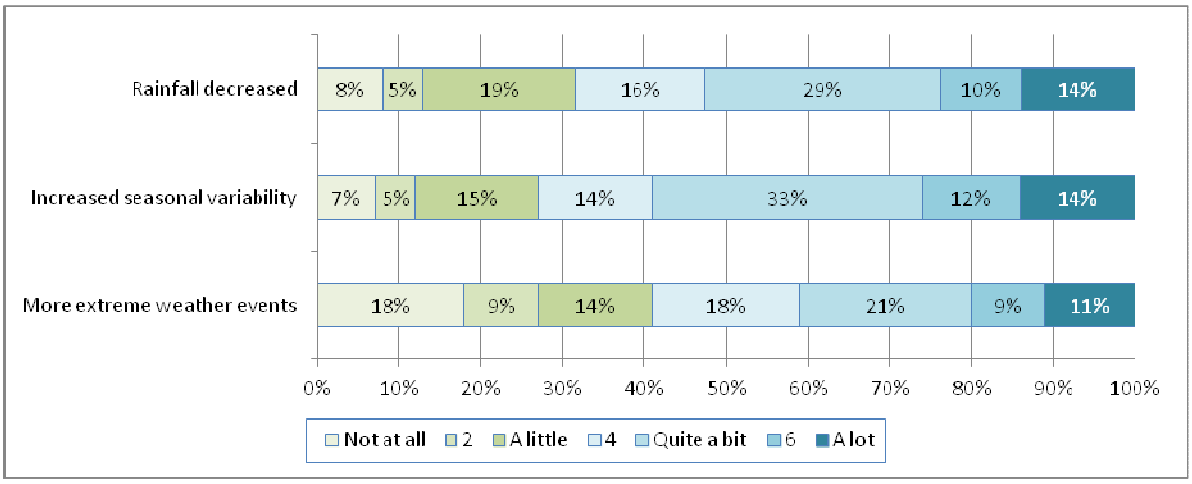

Figure 5.7 Changes in climate over the previous ten years
n=396-400

An examination of the means of responses showed that overall participants had noticed increased variability in the seasons and decreased rainfall over the preceding 10 years compared to increases in frequency of extreme weather events (Figure 5.8).

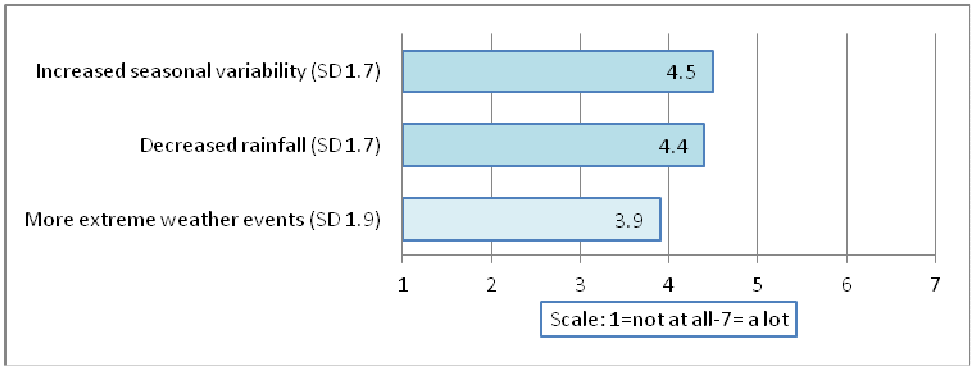

Figure 5.8 Observed changes in climate
n= 396-400

These responses reflected earlier qualitative research undertaken in WA rural and urban regions (DAFWA, 2006) which had found that many participants thought climate change was occurring and believed they were adapting to it. However, the DAFWA (2006) study did not explored in detail if psycho-economic impacts of changes in climate and climatic events influenced participants' attitudes to climate change and their capacity to adapt. In addition to low rainfall, other research has

shown stochastic climatic/weather events such as frost (Biddulph, 2011), heat stress (Asseng, Foster and Turner, 2010), and severe storms and hail could also have an adverse economic impact on farm businesses (Agrimoney, 2012).

Having established that most participants had noticed changes in the climate over the previous 10 years, the research examined farm/agribusiness participant's experiences of their local climate.

5.5 Farm/agribusiness participants' experience of local climate

The research first evaluated farm/agribusiness participant's prior experience of poor seasons. In this instance the questions sought to reflect the farm/agribusiness participants' subjective evaluation of a poor season being related primarily to adverse climatic conditions such as decreased rainfall, frost or heat stress events which had a negative impact on profitability.

Nearly all (82%) of farm/agribusiness participants had been affected by poor seasons during the previous 10 years (1999-2008) (Figure 5.9).

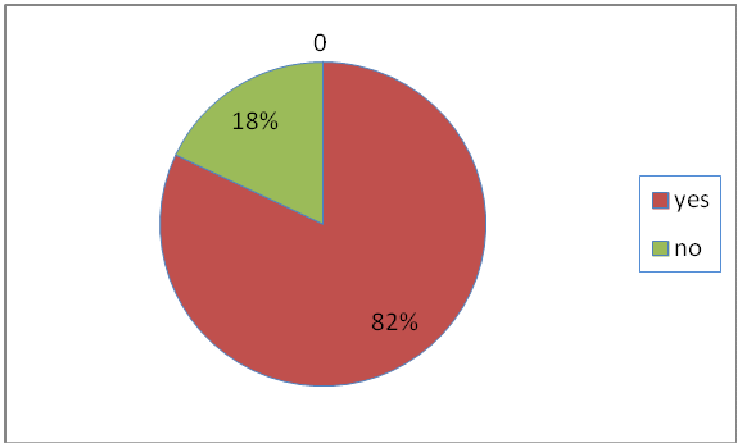

Figure 5.9 Farm/agribusinesses affected by poor seasons in last 10 years
n=298

Low decile rainfall seriously reduced farm income in the Northern Agricultural Region (NAR) during 2006 and 2007 (ANZ, 2006). In addition, southern agricultural regions were affected by decile two seasons during 2000 and 2006 (Beard and Gray, DAFWA Project Managers, pers com, 2008). A map in Appendix seven illustrates Australian rainfall deciles from 2000–2009.

The farm/agribusiness Participants were then asked how many poor seasons had they experienced in the previous 10 years. Responses illustrated a range of experiences over the 10 years with two (27%), three (22%) to four (22%) poor seasons being the most frequent responses (Figure 5.10).

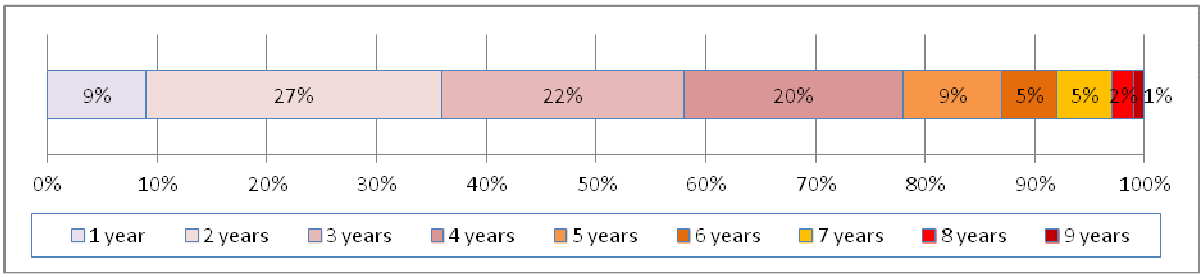

Figure 5.10 Perceptions of poor seasons experienced (1998-2007)
n=237

On average, farm/agribusiness participants had experienced almost three and a half years of poor seasons over the 10 year period. The standard variation indicated a range of just over one and half poor seasons to five poor seasons in ten years (Table 5.1).

Table 5.1 Frequency of poor seasons

	Mean	S.D
Frequency of poor seasons experienced…last 10 years	3.4	1.7

Scale: 1-10 years
N=237

To further extend an understanding of what farm/agribusiness participants had experienced, the research looked at the psycho-economic effects of poor seasons on farms/agribusinesses participants' and families (Figure 5.11).

Impacts on the 82% of farm/agribusiness participants who had been affected by poor seasons included:

- 'Decreased profitability'
  - 72% affected (41% strongly agreed/31% agreed)
- 'Increased debt'
  - 52% affected (26% strongly agreed/26% agreed)

- 'Increased stress'
  - 63% affected (39% strongly agreed/24% agreed)

However, a third (32%) of farm/agribusiness participants thought they had managed poor seasons better than their neighbours and very few had to sell assets to offset economic impacts of the poor seasons.

- 'We managed better than other farms/businesses in the area'
  - 32% were confident (13% strongly agreed/19% agreed)
- 'Assets had to be sold'
  - 14% affected (8% strongly agreed/6% agreed)

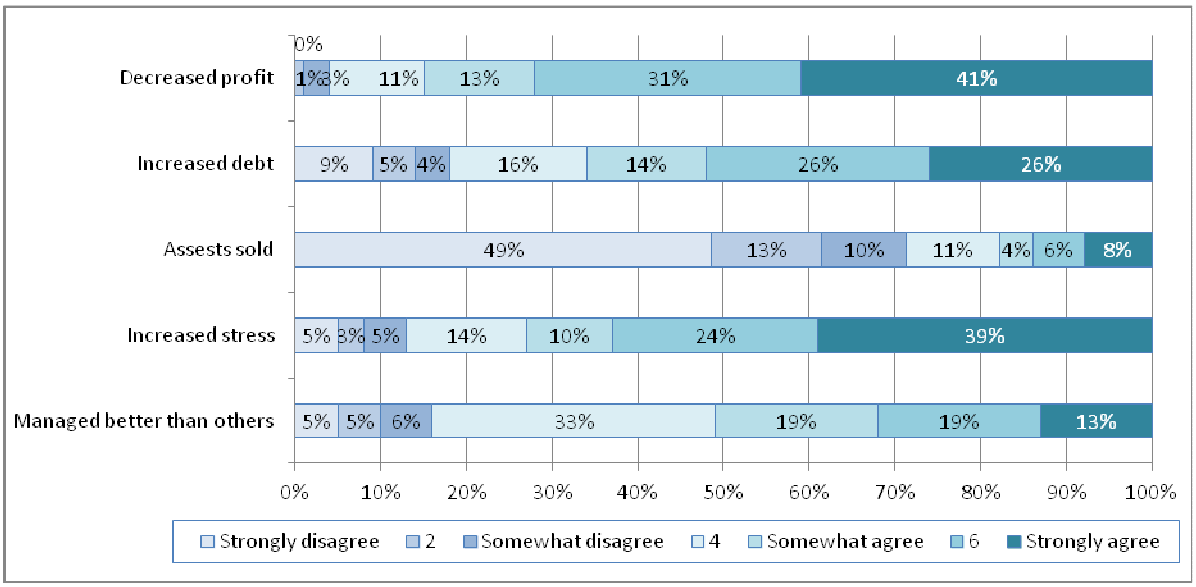

Figure 5.11 Impact of poor seasons on business/family
n= 235-240

Overall most participants experienced decreased profitability, increased stress and increased debt as a result of poor seasons (Figure 5.12). Fewer participants were confident they had managed poor seasons better than others in their area but very few had sold assets as a result of poor seasons.

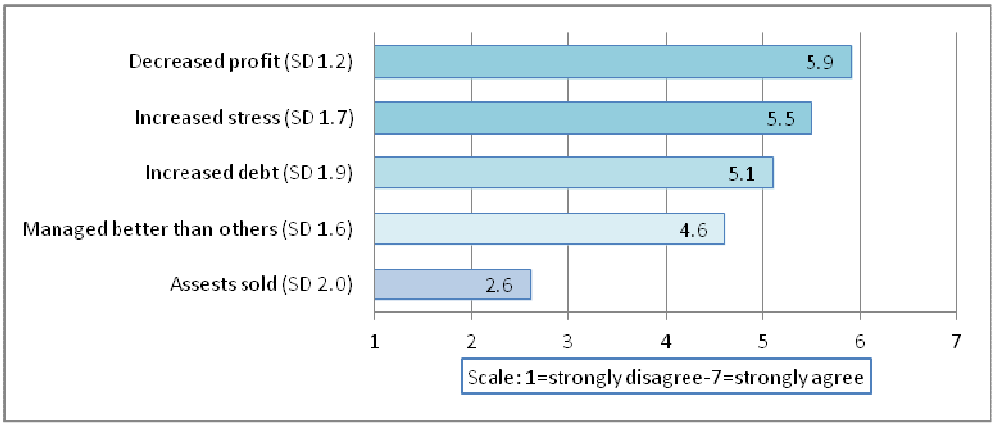

Figure 5.12 Poor seasons' impacts
n=235-240

From the results it can be seen that a high proportion (82%) of farm/agribusiness social structures experienced negative economic and psychological impacts as a result of the poor seasons. Yet 32% were very certain/certain and 19% somewhat certain that they had managed poor seasons better than other farms/businesses around them.

It has been proposed that when people are confronted with uncertainty or risk they use heuristic processes to minimise the uncertainty by attributing predictive values which in turn simplify evaluative judgements (Tversky and Kahneman, 1972), which may result in underestimation or overestimation of a threat/risk (Slovic 1987). These heuristic approaches involve functions such as availability, anchoring and adjustment which give rise to a tendency for people to ignore objective measurable probabilities of threat/risk and use personal subjective knowledge to assess the threat/risk as proposed by Nicholls (1999). To see if there was evidence of heuristic functions influencing participants attitudes the research looked at participants' experience of climate and how they interpreted the implications of those experiences.

5.5.1 Implications of climate change in changes in local climate

To examine the influence of heuristic functions on participant's attitudes, the research asked if participants associated the observed changes in climate and effects of poor seasons with climate change or was the climatic activity viewed as normal for rural WA (Figure 5.13).

Participants' evaluations of what they thought the local climate activity implied in regards to climate change were:

- 'Poor seasons and extreme weather events are linked to climate change'
  - 28% unsure
  - 26% confidently agreed (11% strongly agreed/15% agreed)
  - 22% confidently disagreed (14% strongly disagreed/8% disagreed)

- 'Poor seasons and seasonal variability are just part of living and farming in rural areas'
  - 53% confidently agreed (24% strongly agreed/29% agreed)
  - 19% unsure
  - 8% confidently disagreed (4% strongly disagreed/4% disagreed

Examination of what could have influenced participants' assessment indicated some elements of subjective heuristic evaluation. However, uncertainty was still evident:

- 'There had been worse seasons and droughts than the ones that had just happened'
  - 40% confidently agreed (19% strongly agreed/21% agreed)
  - 24% were unsure
- 'On average over the past ten years the climate had not had a big effect on the profitability of the farm or business'
  - 40% confidently disagreed (24% strongly disagreed/16% disagreed)
  - 21% were unsure.

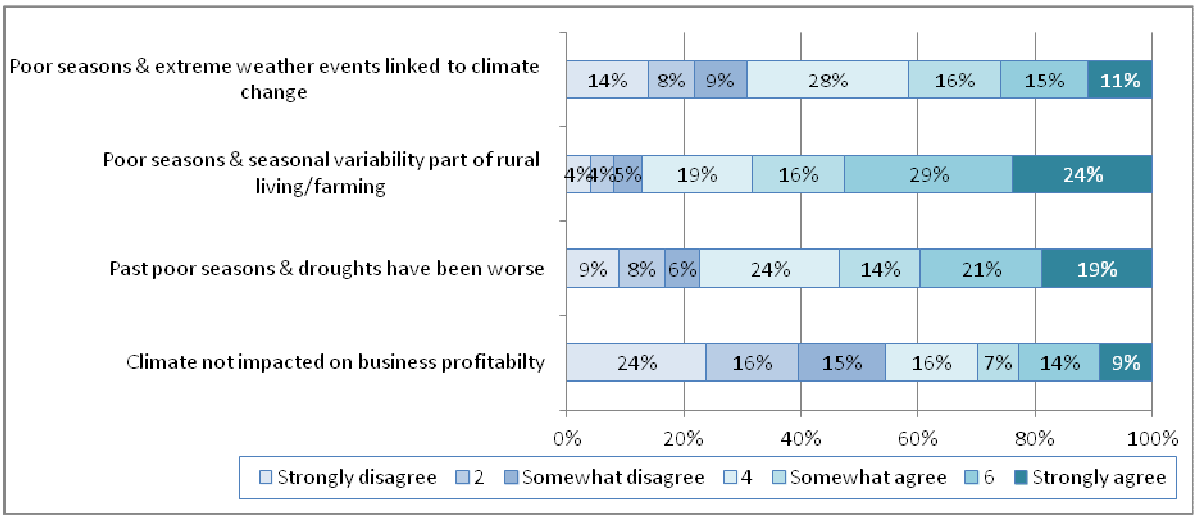

Figure 5.13 Implications of climate activity
n=304-401

Participants were most likely to think that poor seasons and seasonal variability were part of living and farming in rural areas and that there had been worse seasons and droughts than the ones that had just happened (Figure 5.14). There were less certainty poor seasons and extreme weather events were linked to climate change, but most participants did not accept climate had not affected farm/business profitability.

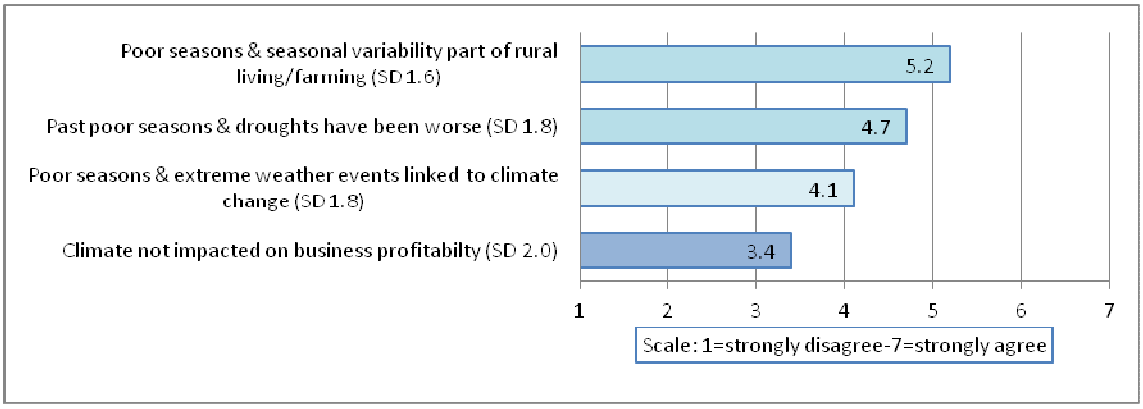

Figure 5.14 Climate activity: normal or linked to climate change
n=385-401

Although participants had noticed changes in climate and 82% of farm/agribusiness participants had experienced poor seasons and adverse impacts as a result of poor seasons, there was a strong tendency to believe droughts and poor seasons were an accepted part of living/farming in rural WA. Given that 40% of farm/agribusiness participants believed there had been worse poor seasons and droughts than the ones that had just happened gave some credence to the possibility that a relatively large number of participants were using heuristic functions of availability, anchoring and adjustment to assess the implications of changes in the climate.

Given this and the potential it represented for conflict between participants' local knowledge and assessment that the variability in climate was normal and science's knowledge which proposed that the climate was changing, the research examined participants' perceptions of science and scientific climate change information and knowledge.

5.6 Validity of science and scientific climate change information

To do this the research looked at participants' perceptions of science and the validity participants attributed scientific climate change information and knowledge. During the earlier Familiarisation study participants had expressed a range of views on the role science had in addressing agricultural issues arising from climate change and its the role in the climate change problem.

There was the view that a collaborative relationship between science and farming communities was imperative.

> *"It's more about scientists and farmers working together."*

> *"Science will no doubt have a part to play. But the ordinary person will have to do their bit and not rely on science to pull them out of trouble."*

In turn there were concerns science would take a position of deciding and imposing scientific recommendations for the best approach.

> *"Yes but farmers will need to be a part of it. Science can't go off and decide what's needed."*

This contrasts the view that ultimately climate change was the responsibility of science:

> *"I haven't really thought about it. I guess it's the job some of them [scientists] have chosen."*

And then there was scepticism about science's climate change agenda:

> *"Climate change will be a funding boom for any scientists that have nothing meaningful to do."*

Studies indicated there were a number of issues in the transfer of scientific climate change information/knowledge to the public. Issues lay between what the public believed to be important and science identified as important coupled with perceptions of relevance and salience to socio-cultural structures and approaches to communicating threat/risk communication (Cash et al., 2002; Botterill and Mazur, 2004;Garvin, 2001; Holloway, 1999).

Issues of relevance, salience and validity were particular contingent to farmers and the broader rural community in relation to climate change. Vanclay and Fleming (2009) found some farmers expected institutions with vested interests would exaggerate threats and impacts of climate change. This suggested a potential for conflict between farming communities' knowledge and science's knowledge. It was this interaction between farming communities' knowledge and science's knowledge and the influence it had on attitudes to climate change which the research assessed (Figure 5.15).

Participants' perceptions of science and the climate change information science provided varied greatly as shown in their responses to the following:

- 'Scientific estimates of climate change have been made without considering all factors involved'
  - 52% confidently agreed (24% strongly agreed/26% agreed)
  - 24% were unsure

- 'Climate change is the latest fashionable funding source for scientists and researchers'
  - 42% confidently agreed (26% strongly agreed/17% agreed)
  - 19% were unsure

- 'Scientists are exaggerating the potential threat of climate change'
  - 32% confidently agreed (15% strongly agreed/17% agreed)
  - 31% were unsure

- 'Science is divided about what is causing climate change to happen faster'
  - 32% confidently agreed (15% strongly agreed/17% agreed)
  - 20% were unsure

- 'Climate change information provided by scientists is useful'
  - 32% confidently agreed (15% strongly agreed/17% agreed)
  - 19% were unsure

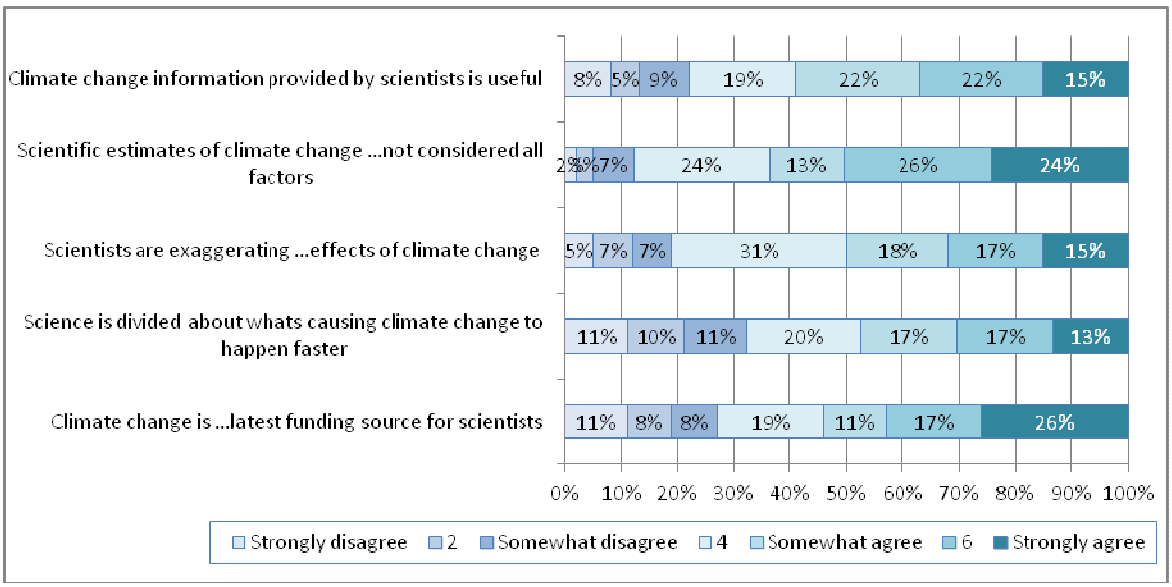

Figure 5.15 Validity of climate science information/knowledge
n=406-410

Generally, results indicated a level of ambiguity in participant perceptions of climate change science (Figure 5.16). On one hand, participants were likely to accept that scientists were providing useful climate change information but at the same time there was also a belief science was not considering all factors involved in its estimation of climate change. There was also a perception scientists were divided about the causes of climate change and were using climate change to access funding opportunities but less certainty they were exaggerating the potential effects of climate change.

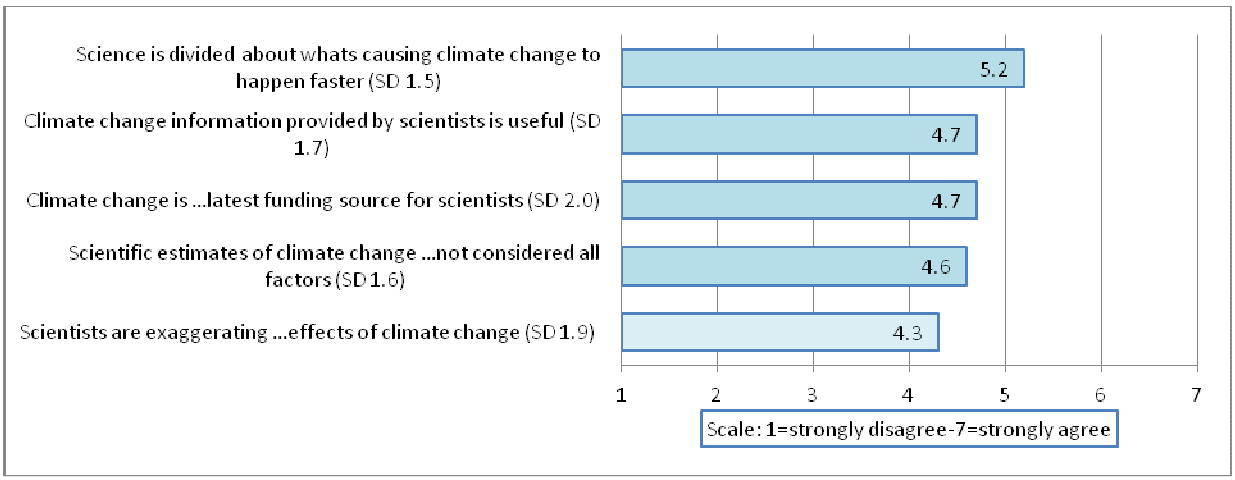

Figure 5.16 Values of science's climate information/knowledge
n=406-410

There was also disparity in participants' views about science's role in climate change (Figure 5.17):

- 'Science should work closely with the agricultural industry and rural communities to find climate change solutions'
  - 67% confidently agreed (39% strongly agreed/28% agreed)
  - 16% were unsure

- 'Government should significantly increase funding of agricultural climate change adaptation research'
  - 59% confidently agreed (29% strongly agreed/30% agreed)
  - 16% were unsure

- 'Humans will adapt naturally as the climate changes'
  - 36% confidently agreed (11% strongly agreed/25% agreed)
  - 19% were unsure

- 'The ordinary person will contribute as much to climate change solutions as scientist'
  - 34% confidently agreed (11% strongly agreed/23% agreed)
  - 19% were unsure

- 'Science cannot solve the climate change problem'
  - 28% confidently disagreed (13% strongly disagreed/15% disagreed)
  - 20% were unsure

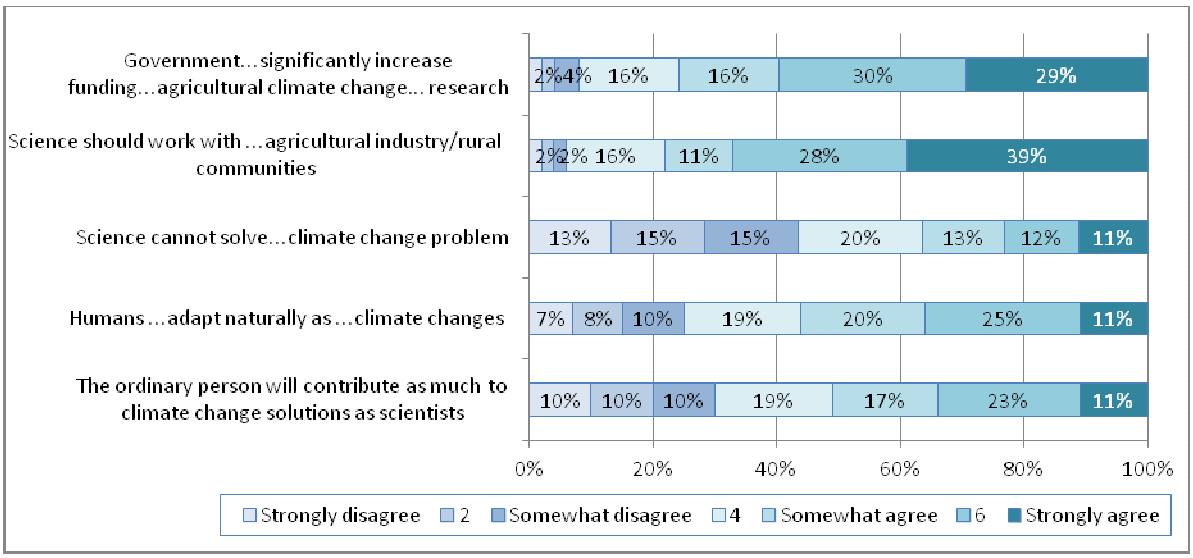

Figure 5.17 Science's role in climate change
n=406-409

There was support for science to cooperate with agriculture and rural communities to find solutions for climate change and for government to increase climate change research funding (Figure 6.20). There was also a belief humans would adapt as the climate changed and ordinary people would contribute as much to solutions as scientists. However, there was less inclination to accept that science could not solve the climate change problem. Overall results indicated more dissatisfaction with science than had been shown in Fleming and Vanclay's (2009a) study in which 18% of farm/agribusiness participants had exhibited distrust of science.

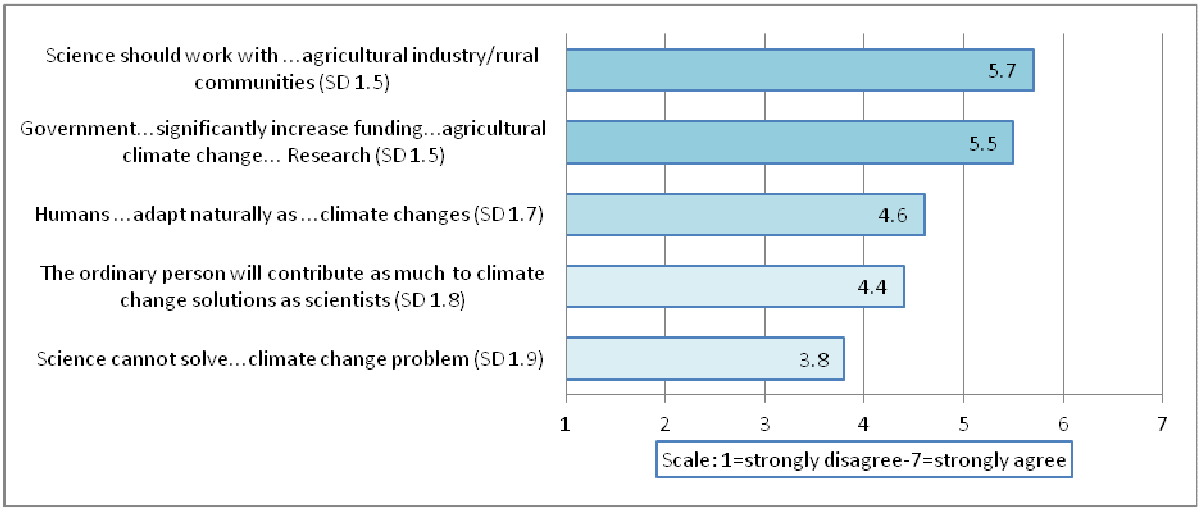

Figure 5.18 Science's role in climate change solutions
n=402-409

These results demonstrated some disparity and conflict in participant's views of science. While there was some questioning of science's credibility and agendas there was also an expectation that science had an important role to play in addressing the problems climate change posed for agriculture.

To further evaluate participant perceptions of scientific climate change information, the research examined the importance they attributed to being informed about climate change and their responses to scientists climate change views and scientific information sources in addition to the comprehensibility of climate change information.

5.6.1 Value and comprehensibility of climate change information

There was consensus among participants that: 'it was important to keep informed about climate change' (mean 5.6) (Figure 5.19). Over a third (37%) believed it was very important and 22% thought it important.

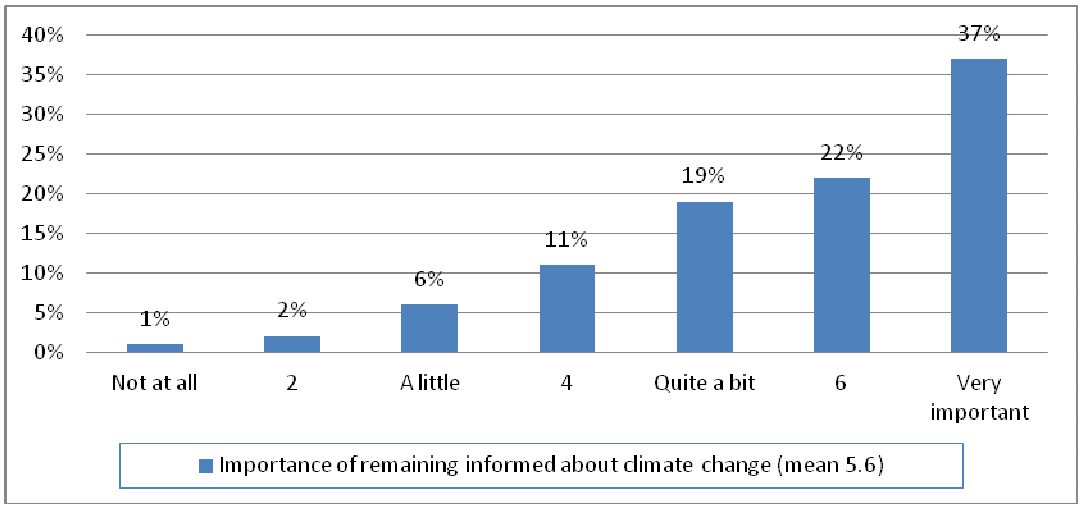

Figure 5.19 Staying informed about climate change
n= 400

In regard to scientists climate change views and science's climate change information, most participants valued scientists views (mean 2.0) but were less sure about the importance of the information science provided (mean 1.4) (Figure 5.20):

- 'Value the climate change views of scientists' 72% greatly valued (33% highly valued/36% valued)

- 'Science publications are an important source of climate change information'
  - 48% especially important (18% very important/30% important)

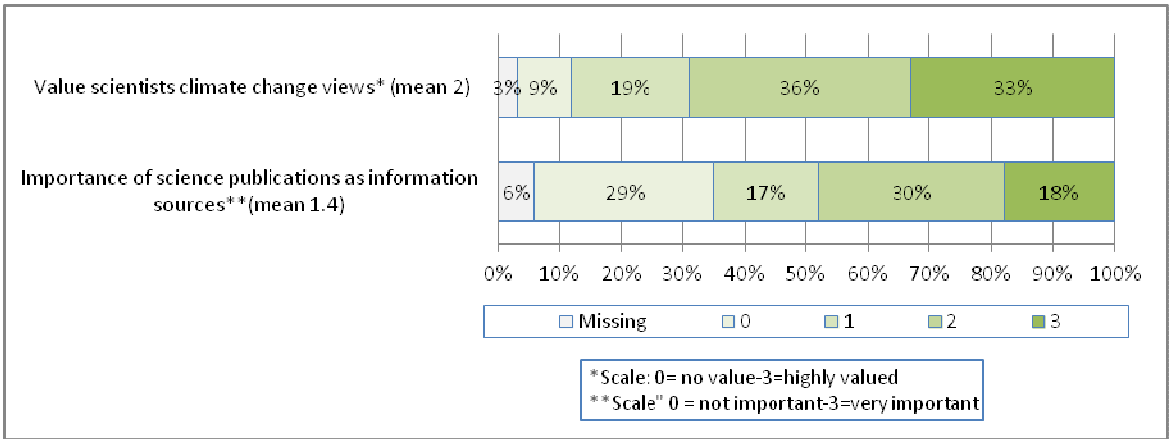

Figure 5.20 Value/importance of scientific information/knowledge
n=411

The conflicting responses between the value credited to scientific views about climate change and the lower importance ascribed to scientific publications could have been attributed to how easily they understood the information (Figure 5.21). Only 33% thought climate change information was easy to understand, whereas 61% did not think it was easy to understand.

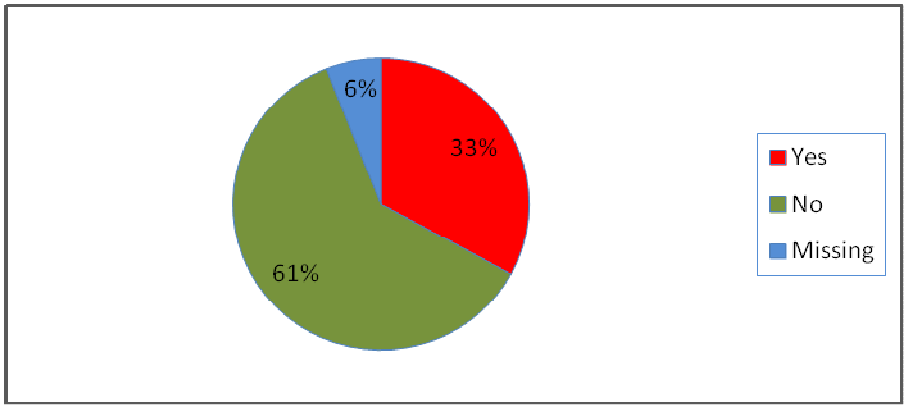

Figure 5.21 Understanding climate change information
n= 411

To see if the ease of understanding climate change information influenced participant responses to science's climate change information and knowledge, a comparison analysis using an Independent T-Test was undertaken. A comparison was made between responses to: 'Is climate change information is easy to

understand' with: 'Climate change information provided by scientists useful'; 'Value views and opinions about climate change-Climate change scientists and researchers' and 'Sources that give you the most useful climate change information-Science publications' (Figure 5.22).

Comparisons indicated significant differences between participants who found climate change information easy to understand and those who did not to all three statements concerning the value of scientific information and knowledge. Participants who believed climate change information was easy to understand also thought climate change information provided by scientists was more useful than participants who did not think climate change information easy to understand (Figure 5.22).

Equally, participants who found climate change information was easy to understand were more likely to attribute more value to the climate change views and opinions of scientists compared to those who did not find climate change information easy to understand (Figure 5.22).

Similarly those who believed climate change information was easy to understand were more inclined to think science publications were important information sources than participants who did not think climate change information was easy to understand (Figure 6.24).

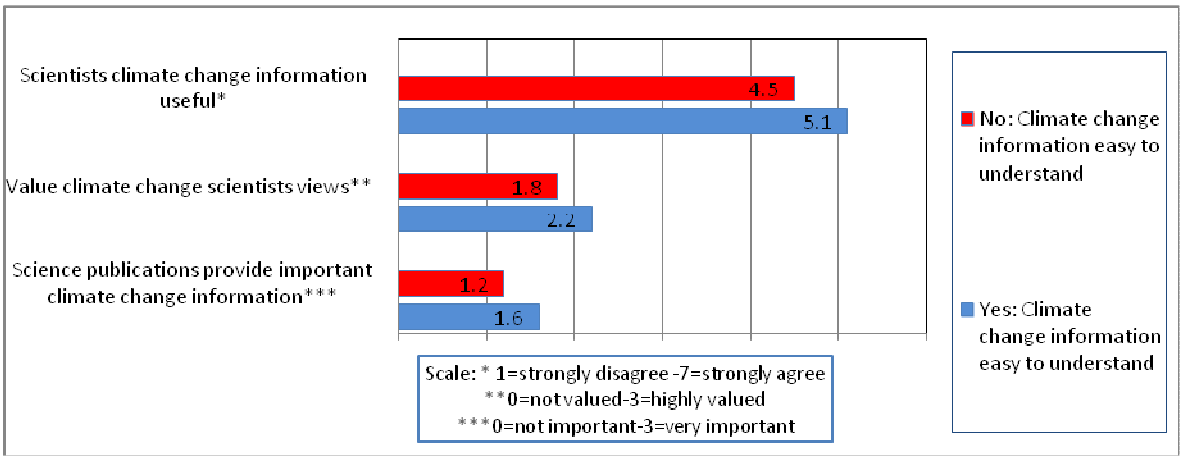

Figure 5.22 Understanding information and valuing science information sources
n=370-381 (Equal variances assumed- all Two Tailed p<0.01)

The relationship illustrated between the ease of understanding climate change information and the values ascribed to the information and views of science suggest this could be an additional element in influencing participants' attitudes to climate change and climate change threat. However, the results at this point did not explain what could be contributing to some participants being able to easily understand climate change information more than other participants. Was it that some participants simply found scientific climate change information hard to understand or was it as Holloway (1999) proposed because there was conflict between scientific climate knowledge forms and participant's rural/farming knowledge forms?

5.7 Discussion

Participants' responses portrayed a complexity and uncertainty in attitudes to climate change which extended beyond the simple assessment of: 'is climate change occurring?' The results illustrated a certain level of ambiguity in participants' responses to climate change, and climate change threat. Only a third (36%) were sure climate change was occurring and a quarter (24%) sure it was not natural. Responses also indicated a degree of indecisiveness in participants' perceptions of climate change threat to their communities and businesses. Although participants tended to perceive climate change as a possible threat to communities (mean 4.7), farm/agribusiness participants were less certain it was a threat to the future of their businesses (mean 4.3). A perception reflected in the low importance they rated climate change in impacting on the economic sustainability of their businesses compared to more influential short term costs of fuel, fertiliser and chemicals and medium term to long concerns of interest rates, environmental sustainability and labour shortages.

Awareness and perception of threats/risks are, as Rogers (2003) proposed, contingent elements in the early stages of the adoption/adaptation process. However, this research showed, as had been found in other studies, that there were differences between awareness of climate change and willingness to take action (Anable et al., 2006; Dunlap and Saad, 2001; Langford, 2002; Maibach et al., 2009). Although 52% of participants did not agree there was no need to respond to climate change, only 30% indicated they were responding.

The socio-cultural construction of risk described by Covello and Johnson (1987) in addition to definition of threat/risk being either natural or human-induced as Finucane (2000) proposed appeared to be contingent elements in participant responses. There seemed to be relatively consistent if somewhat broad groups of responses structured along the lines of climate change being natural or human-induced. A fifth (21%) of participants thought climate change was natural with 24% who did not perceive it as a threat to farms/agribusinesses and 18% who did not think it was threat to rural communities. Additionally 24% did not think climate change was important to the economic sustainability of their businesses and 20% believed or somewhat thought there was no need to respond to climate change. Conversely 24% of participants believed climate change was not natural and 33% perceived it both as a threat to farms/businesses and important to the economic sustainability of their businesses. Similarly 30% believed there was a need to respond to climate change and they were responding.

It also appeared that socio-cultural conceptualisation of risk/threat was layered across perception of risk type. Despite many participants acknowledging that in the past 10 years there had been an increase in seasonal variability, a decrease in rainfall and to lesser extent more extreme weather events, most felt poor seasons and seasonal variability were a normal part of living/farming in rural WA. This was in contrast to the IPCC view which held that these changes in climate were symptomatic of climate change in south western regions of Australia (Hennessy et al., 2007). Essentially only a quarter (26%) of participants thought along the same lines as the IPCC and believed the changes in climate were related to climate change.

The socio-cultural conceptualisation of risk/threat was further illustrated by the farm/agribusiness participant's responses to future climate threat to their businesses and the importance they attributed to climate change impact on business economic sustainability. As had been shown with farmers in other research in Mozambique (Patt and Schroter, 2008), South Africa (Gbetibouo, 2008) and the UK (Holloway, 1999), farm/agribusiness participants did not view climate change as a priority or insurmountable threat.

And yet socio-cultural conceptualisation of risk/threat within constructs of local knowledge forms led to only partial conflict with science knowledge forms. While 46% of participants thought science publications were not very important sources of climate change information, 69% valued the views of climate change scientists. Although there was questioning of science's credibility there was also acknowledgement that science had an integral role to play in dealing with climate change.

However there appeared to be relationship between comprehensibility of climate change information and importance attributed to science's information. Just a third (33%) of participants found the information easy to understand and slightly more (37%) believed information provided by scientists was useful. But this seemed to be only part of the answer because while 61% of participants did not think the information was easy to understand, only 22% thought the information provided by scientists was not useful.

There was however the possibility that the ease of understanding climate change information did not automatically point to an issue of comprehensibility. Another Australian study (Bulkeley, 2000) had shown that indifference to climate change information could also factor. The low level of understanding climate change information in this research may have been, as Holloway (1999) proposed, a question of relevance or importance.

As stated at the beginning of the chapter, there were several different but interrelated stories emerging from groups of responses to climate change. To more fully explore these stories the research examined if interdependent relationships were present between groups of participants' extrinsic characteristics and their intrinsic values of climate change and science as had been identified by Maibach et al. (2009). If this was the case, this research could add to Fleming and Vanclay (2009), research which identified four rural/farming discourses of climate change, and provided a basis to develop social profiles of rural/farming climate change typologies.

Profiling of Australian farmers/landholders socio-cultural and environmental values, along with land-use and resource-use behaviours has been developed to target cost-effective promotion of environmental policy initiatives (Bohnet, 2008; Emtage and

Herbohn, 2012; Kuehne et al., 2007). There is an opportunity through this research to extend social profiling to climate change values and characteristics. This would better facilitate diffusion of climate change information and knowledge through the WA rural sector. A multivariate analysis was used to identify typological characteristics of participants' climate change and science values. The results are described in the following chapter (Chapter seven) after which Chapter eight will report on participants' perceptions of government's role in climate change and Chapter nine will describe results of network profiling of climate change information/knowledge sources.

Chapter 6: Climate Change; Attitude Values and Characteristics

6.1 Chapter Outline

The spread of responses to the occurrence of climate change and perceptions of science's role in climate change depicted in Chapter six offered only a limited explanation of what participants thought. The results did not demonstrate what could be influencing participants' responses. This chapter examines the characteristics and values of participants and through multivariate analysis (PATN 2.3; Belbin 1993a) draws together associations of rural climate change typological attributes (Section 6.2). A Principle Component Analysis was used to identify further interdependent relationships between values (Section 6.3). ANOVA and associated tests were used to compare differences between participants' characteristics (Section 6.4) as well as responses to climate change values and values of science (Section 6.5), in addition to environmental values (Section 6.6).

6.2 Grouping participants: Climate change values, attitudes and affinities

Research conducted in the US identified six typologies of climate change attitudes based on associations of participants' socio-demographic characteristics and intrinsic attitudinal values related to climate change (Maibach et al., 2009). However, although two qualitative Australian studies of farming communities have identified some core responses to climate change, development of typological profiles of climate change attitudes within farming communities was limited (Fleming and Vanclay, 2009; Milne et al., 2008). The quantitative element of this research and a larger sample set offered the opportunity to profile characteristics and intrinsic climate change values across a larger and more socially and spatially diverse rural/farming community.

In profiling the typological characteristics of participants the research examined responses to three elements of: climate change; science and scientific knowledge/information; and understanding of climate change information. This approach was taken as Maibach et al.'s (2009) study had demonstrated the influences of these variables in developing typologies. To develop the attitudinal profiles of participants this research divided the questions into four sets of values.

The first set of values evaluated was attitudes to climate change (Chapter five, Section 5.2):

- ‘Climate change is occurring’
- ‘Climate change is a natural climatic cycle… not influenced by greenhouse emissions’

The second set of values addressed perceptions of climate science’s credibility and integrity (Chapter five, Section 5.5):

- ‘Climate change information provided by scientists is useful’
- ‘Scientific estimates of climate change have been made without considering all factors involved’
- ‘Scientists are exaggerating the potential effects of climate change’
- ‘Science is divided about what is causing the climate to change faster’
- ‘Climate change is the latest fashionable funding source for scientists/researchers’

The third set of values considered examined broader perceptions of sciences and the rural public’s capacity to respond to climate change as well as the relationship between science and rural people (Chapter five, Section 5.5):

- The ordinary person will contribute as much to climate change as scientists
- Humans will adapt naturally as the climate changes
- Science cannot solve the climate change problem
- Science should work closely with the agricultural industry and rural communities to find climate change solutions

The fourth value examined was the single value of being able to understand information about climate change (Chapter 5, Section 5.5.1):

- Climate change information is easy to understand

The multivariate analysis (PATN 2.3; Belbin, 1993a) revealed three main clusters of values and a single value cluster (Figure 6.1). The description of the statement and the meaning in the context of the analysis is represented by the abbreviated variable label relevant to cluster values is contained in Table 6.1.

There were significant associations (P<0.01) in the first cluster between participants' values associated with climate change occurring, valuing science and science climate change information (Table 6.1).

- 'Accept'; *'Climate change is occurring'* (r^2 0.051)
- 'InfoUsefulQ10'; *'Climate change information provided by scientists…useful'* (r^2 0.059)
- 'Scientists'; *'Value: Scientists/researchers climate change views and opinions'* (r^2 0.236)
- 'SciPub'; *'Science publications…important sources of climate change information'* (r^2 0.109)
- 'Cooperate'; *'Science needs to work closely with…agriculture & rural communities in finding climate change solutions'* (r^2 0.022)
- 'CCInfo', *'Yes: Climate change information is easy to understand'* (r^2 0.046)

There were two significant associations (P<0.01) in the second cluster between values and participants being:

- 'Sceptic'; *'Climate change is…a natural climatic cycle and not influenced by greenhouse emissions'* (^{r2} 0.056)
- 'SciUnable'; *'Science cannot solve the climate change problem'* (r^2 0.016)

Significant associations (P<0.01) between values and participants in the third cluster were:

- 'NotAll'; *'Scientific estimates of climate change…made without considering all factors involved'* (r^2 0.041)
- 'NatAdapt'; *'Humans will naturally adapt…climate changes'* (r^2 0.035)
- 'Divisive'; *'Scientists cannot agree about what is causing climate change to happen faster'* (r^2 0.051)

- 'Exaggerate'; '*Scientists are exaggerating the potential effects of climate change*' (r^2 0.082)
- 'SciFund', '*Climate change…latest fashionable funding source for scientists/researchers'* (r^2 0.114)

The final cluster indicated just one significant association (P<0.01) between a value and participants (Figure 6.1):

- 'PeopleDo' *'The ordinary person will contribute as much to climate change solutions as scientists'* (r^2 0.023)

Apart from the variable 'PeopleDo', this cluster shared associations with participants in the third cluster and as such was combined with the third cluster.

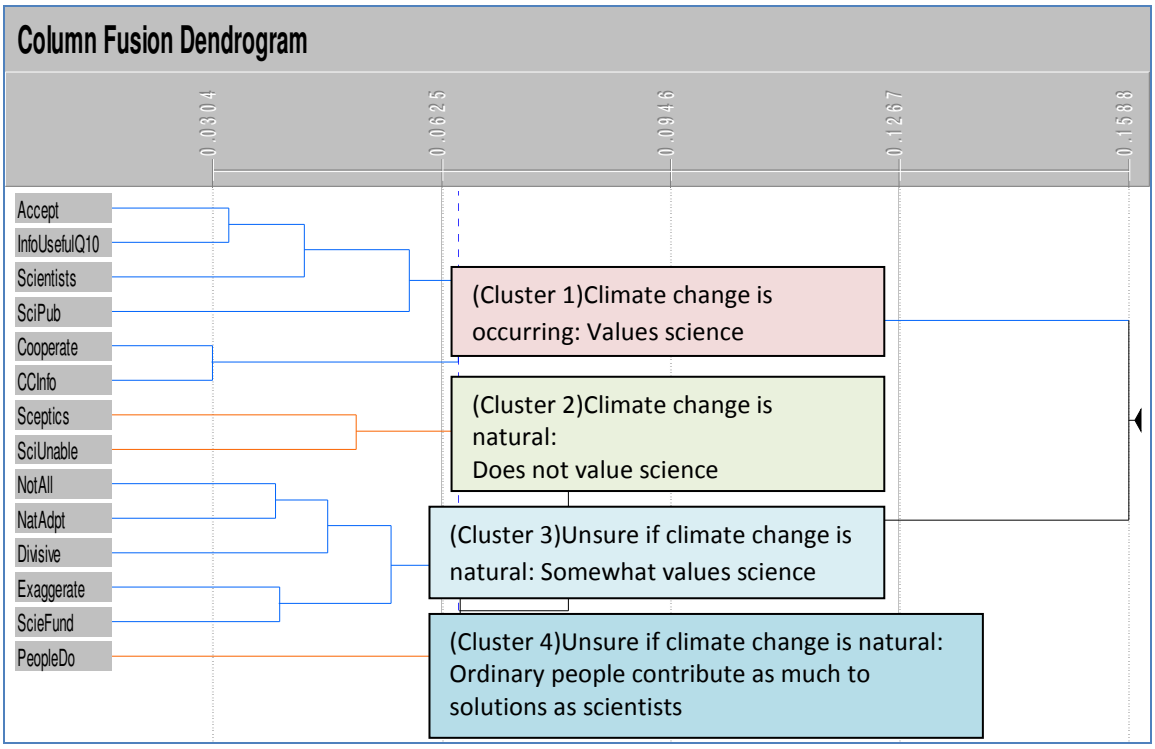

Figure 6.1 Column Fusion Dendrogram of value clusters

Bray Curtis, UPGMA Beta, -0.5

Table 6.1 Cluster values

Statement	Variable label	r – squared derived from Principle Axis Correlation Pcc
Climate change is occurring	Accept	0.051
Climate change information provided by scientists…useful	InfoUseful	0.059
Value: Scientists/researchers climate change views and opinions	Scientists	0.236
Science publications…important sources of climate change information	SciPub	0.109
Science needs to work closely with…agriculture & rural communities in finding climate change solutions	Cooperate	0.022
Yes: Climate change information is easy to understand	CCInfo	0.046
Climate change is…a natural climatic cycle and not influenced by greenhouse emissions	'Sceptics'	0.056
Science cannot solve the climate change problem	SciUnable	0.016
Scientific estimates of climate change…made without considering all factors involved	NotAll	0.041
Humans will naturally adapt…climate changes	NatAdapt	0.35
Scientists cannot agree about what is causing climate change to happen faster	Divisive	0.051
Scientists are exaggerating the potential effects of climate change	Exaggerate	0.082
Climate change…latest fashionable funding source for scientists/researchers	SciFund	0.114
…ordinary person will contribute as much to climate change solutions as scientists	PeopleDo	0.023

The Two-way table derived from the multivariate analysis (PATN 2.3; Belbin, 1993a) depicts the grouping of participants and values (Figure 6.2). The table illustrates relationships of statistical associations between participants within each group correlated with the variables displayed in Figure 6.1 and Table 6.1.

The five colours displayed in the Two-way table (Figure 6.2) (see legend on the bottom left hand side of the table) depict the strength of correlations between the

intrinsic variables (responses to questions) displayed across the top of the table and individual participants displayed down the left hand side of the table (due to the illegibility of the variables at the top of the table the variables are described in the relevant cluster boxes on the left side of table).

The degrees of correlation range from white (no correlation of associations between participants and values) through increasing shades of blue to black (the highest degree of correlation of association). The Two-way table shows nine distinct clusters of correlations between participants and variable values. The clusters represented 97% of the survey sample (n=398).

There was one large cluster which comprised 50% of participants and two smaller clusters that comprised 18% and 15% of the survey sample, while the remaining 14% made up the other six small clusters. The three largest clusters of values held the most interest to the research. Although participants in the smaller clusters may have shared value/values with other clusters, they did not share a range of values which defined the larger clusters. This could have been for a number of reasons such as participants in the smaller clusters responding differently to other variables or not responding at all. Descriptions of these smaller clusters are reported in Appendix nine.

The three largest clusters of significant statistical associations of values provided intrinsic typological values that contributed significantly to development of rural climate change typologies (Figure 6.2).

The 'Uncertain' value cluster represented 50% of the survey sample. Generally, participants in this cluster were uncertain if climate change was a natural climatic cycle. Statistical associations of values were:

- 'Science had not considered all of the factors in its estimation of climate change'
- 'Humans would adapt naturally as the climate changed'
- 'Scientists could not agree about what was causing climate change to accelerate'
- 'Scientists were exaggerating the potential effects of climate change and using climate change as source for funding'

The 'Sceptics' value cluster comprised 15% of the survey sample. There was a level of correlation in the cluster with the value that climate change was the latest funding source for scientists/researchers. Statistical associations within the cluster were:

- 'Climate change was part of natural cycle and not influenced by greenhouse emissions and science could not solve the climate change problem'

The 'Acceptors' value cluster included 18% of the survey sample. There was little to no correlation within this group with the value that climate change was a natural climatic cycle. Statistical associations of values were:

- 'Accept climate change was occurring'
- 'Scientific climate change information useful'
- 'Value the climate change views of scientists'
- 'Science publications were an important source of information'
- 'Science and agriculture/rural communities should cooperate to find solutions for climate change'
- 'Climate change information was easy to understand'

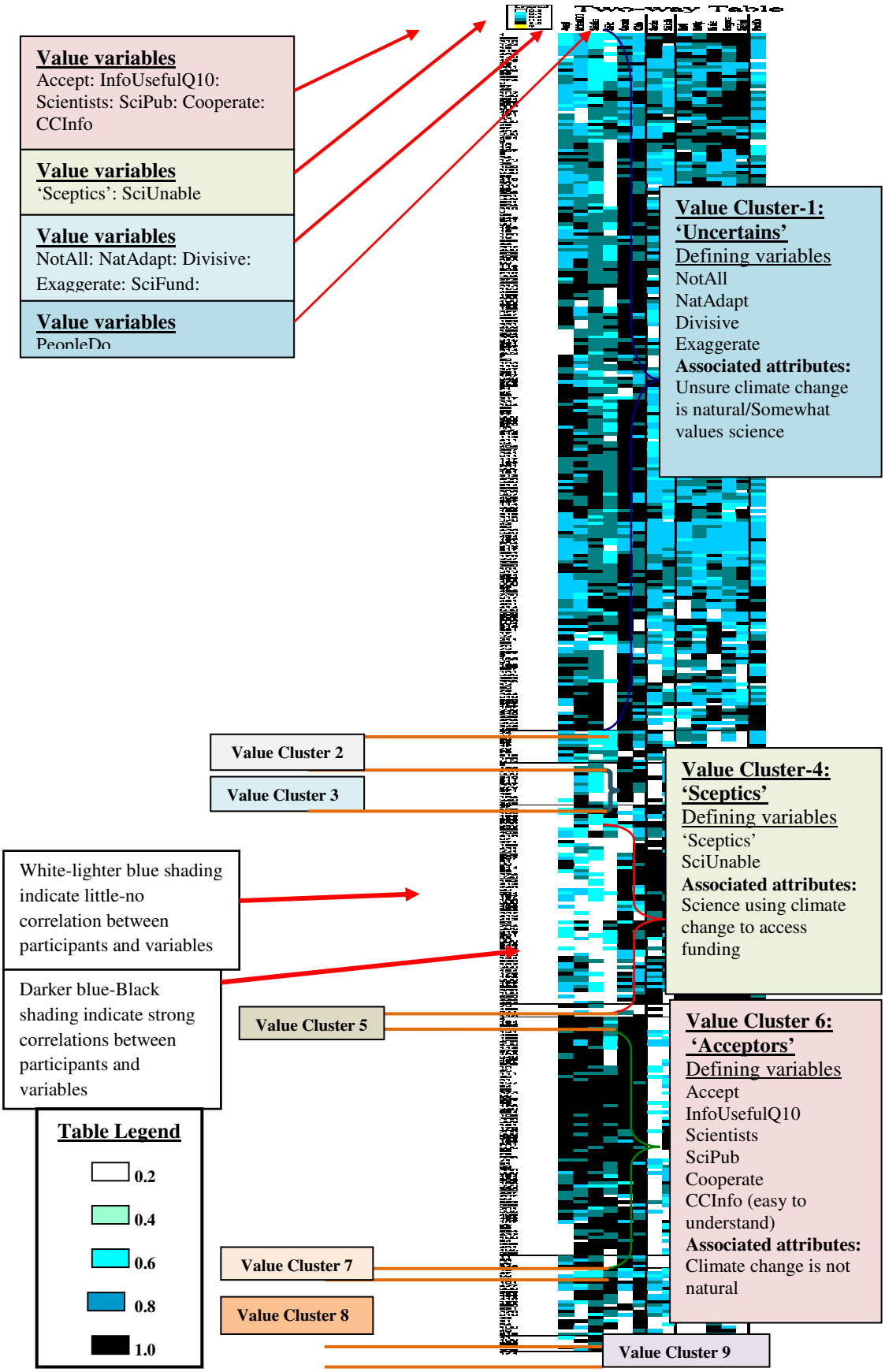

Figure 6.2 Clusters of values
Bray Curtis, UPGMA Beta, -0.05: (n=411)

The Two-way table identification of individual participants in the 'Acceptors', 'Uncertains' and 'Sceptics' clusters provided an opportunity to explore additional defining characteristics of the clusters. Individual participant responses from each cluster were entered into a new data set and analysed with SPSS (2009) statistical procedures. The other six small clusters were excluded from further analysis because checking the data indicated that in a majority of cases participants had not responded to a high number of questions. A description of these minor clusters is available in Appendix eight.

Initially, Factor analysis was used to examine the set of interdependent associations identified in the Column Fusion Dendrogram (Figure 6.1) with other variables associated with climate change and science.

6.3 Principal components of climate change and science

Statements regarding perceptions of climate change threat, linkages between local climate activity and climate change and the need to respond were included in the Factor analysis to expand the examination of interdependent associations between responses to climate change. As this was exploratory research, the purpose of the analysis was to explore which questions were answered in a similar way by survey participants to better understand if some questions were similar to each other and identify what questions, variables and/or factors could be included or excluded from future research.

The Kaiser, Meyer and Olkin measure of sampling adequacy of 0.89 suggested the Factor analysis of variables would be useful (Chi-square 2007.6, df 253, P=0.00). Principle Component Analysis (PCA) described six factors with Eigen values greater than one that explained 59% of variance (Table 6.2). This level of variance was marginally under 60%, which is regarded as sufficient in explaining contributing elements of associations. As such, the variance of 59% suggests there are other unknown variables that could influence responses. In addition, reliability scaling indicated that only two of the factors were reliable.

Table 6.2 Components of climate change and climate change science

Statements about climate change and science	Component					
	1	2	3	4	5	6
Climate change is a major threat to the future of rural communities	0.80					
Climate change is a major threat to the future of my business (farming/ rural business)	0.73					
Poor seasons & extreme weather events are linked to climate change	0.72					
Climate change is occurring	0.61					
I will wait and see if there is a need to respond to climate change*	-0.48					0.43
There is no need to respond to climate change*	-0.47					
Climate change information provided by scientists is useful	0.41					
Climate change is the latest fashionable funding source for scientists/researchers		0.72				
Scientific estimates of climate change have been made without considering all factors involved		0.68				
Humans will adapt naturally as the climate changes		0.63				
Scientists are exaggerating the potential effects of climate change *	-0.42	0.62				
Science is divided about what is causing climate change to happen faster		0.56		0.5		
Science cannot solve the climate change problem		0.53			0.52	
Climate change is a natural cycle and not influenced by greenhouse emissions*	-0.42	0.45				
Important to remain informed about climate change			0.68			
Science should work closely with agriculture/rural communities to find climate change solutions			0.6			
There is a need to respond to climate change and I am responding			0.59			
The ordinary person will contribute as much to climate change solutions as scientists			0.47			
Past poor seasons & droughts have been worse				0.75		
Poor seasons & seasonal variability are just part of the natural climate cycle				0.68		
On average over the past 10 years climate has not had a big impact on profitability of the farm/business					0.68	
There is a need to respond to climate change but I am not sure what to do*	0.46				-0.51	
Climate change is occurring but will not occur in my local region						0.84
Eigenvalue	7.0	1.6	1.4	1.3	1.2	1.1
Percentage Variance (%)	30.6	6.8	5.9	5.7	5.2	4.8
Cumulative Variance (%)	30.6	37.4	43.2	48.8	54	58.8
Cronbach's Alpha	0.88	0.82	0.54	0.52	0.44	0.34

*Negative value indicated meaning of variable was reversed
Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 15 iterations.

The six factors extracted explained attitudes associated with: the threat of climate change; scepticism about climate change being human-induced; issues of inclusive cooperation with science in finding adaptive solutions; influences of local knowledge on attitudes and perceptions; scepticism of threat and denial of threat (Table 6.2).

Factor 1: 'Climate change threat'

Factor one 'Climate change threat' comprised attributes associated with climate change threat which included perceptions that local climate activity was linked to a climate change that was not natural and there was a need to respond effectively without waiting to see what would happen. This factor also indicated associations between perceptions of climate change and threat with usefulness of scientific information which in part was not exaggerating the potential effects of climate change.

A Cronbach's alpha of 0.87 indicated the factor was reliable. However, when the variables: 'Climate change information provided by scientists is useful' and 'Scientists are exaggerating the potential effects of climate change' were omitted, the Cronbach's alpha increased slightly to 0.88. If these variables were to be excluded from the factor it is recommended they be included in future research as single variables.

Factor 2: 'Climate change scepticism'

Factor two 'Climate change scepticism' represented attitudes or perceptions of scepticism about climate change and climate change science. This factor depicted interdependent relationships in responses between science and scientist's credibility, integrity and validity of scientific information with science's inability to solve climate change and the capacity of humans to adapt to what was perceived as a natural process of change. Reliability scaling of this factor also indicated the factor was sufficiently robust with a Cronbach's alpha of 0.82.

Factor 3: 'Collaboration and response'

Factor three 'Collaboration and response' included the elements of importance of information and equality in collaboration with science in ensuring a proactive and

effective response to climate change. However, a Cronbach's alpha of 0.54 indicated this factor was not sufficiently reliable. As such, in future research it is suggested these variables are used as single questions.

Factor 4: 'Local knowledge'

Factor four 'Local knowledge' captured the heuristic values of availability, recall and adjustment of past events in substantiating that local climate activity was normal and to be expected. This knowledge was further validated by sciences' inability to agree on what was causing the climate to change faster, which suggested tensions between acquired local knowledge and knowledge perceived as formed at a distance. A Cronbach's alpha of 0.52 indicated this factor was also not sufficiently reliable. This being the case, it is recommended that these questions also be used in future research as single questions.

Factor 5: 'Hollow threat'

Factor five 'Hollow threat' incorporated the elements of an unrealised threat that could be responded to. The inclusion of science not being able to solve the climate change problem in the factor did not fit logically with the other variables in the factor. A Cronbach's alpha of 0.44 demonstrated this factor too was not sufficiently reliable. Again, it is suggested these questions be included in future research as single questions.

Factor 6: 'Not happening here'

Factor six 'Not happening here' included the element of belief that climate change would not occur in specific or particular areas and as such it was necessary to wait and see if a response was required. This factor was also insufficiently reliable with a Cronbach's alpha of 0.34. As before, these questions could also be used in future research as single questions. However, participants' responses to the question of climate change not affecting a particular area (their local area) as reported in Chapter six (Section 5.1) suggest the question may be considered redundant in terms of future research.

Although four of the six factors proved to be insufficiently reliable, the reliability of the factors 'Climate change threat' and 'Climate change scepticism' suggested there

were additional values to those identified in the PATN analysis (Table 6.2) that influenced participants' attitudes and perceptions about climate change. The factor 'Climate change threat' suggested additional perceptions about climate change threat and assessment of potential threat derived from local knowledge influenced 'Acceptors' views of climate change. Alternately, the factor 'Climate change scepticism' indicated additional values to climate change being a natural climatic cycle and science being unable to solve the climate problem. This factor included less favourable perceptions of science's credibility and integrity and confidence in humans' adaptive capacities. Having identified the importance of these factors in contributing to participants' views of climate change and science, the research examined who were 'Acceptors', 'Uncertains' and 'Sceptics'.

6.4 Extrinsic characteristics of 'Acceptors', 'Uncertains' and 'Sceptics'

Although the multivariate analysis (PATN, 2.3: Belbin 1993a) had shown significant defining associations of specific variables between participants within each cluster, there remained questions as to the degree of differences between cluster responses to these variables and other associated variables. Further analysis undertaken with ANOVA and 'Sidak' Post Hoc Tests, along with 'Brown-Forsythe' and 'Welch' tests if necessary, in conjunction with the 'Tamhame' Post Hoc Test were used to identify significance of differences of characteristics between the clusters. ANOVA was used to check significances of difference and 'Sidak' Post Hoc Tests were used to identify which questions were different if variance distribution was normal. If variance distribution was not normal, the 'Brown-Forsythe' and 'Welch' tests were used to check significances of difference and the 'Tamhame' Post Hoc Test was used see which questions were different.

The first approaches undertaken aimed to develop social demographic profiles of participants in the 'Acceptors', 'Uncertains' and 'Sceptics' clusters to better describe the differences between who were included in each of the clusters. Studies involved in development of social profiles of landholders'/farmers' environmental values and behaviours had included extrinsic descriptor characteristics of: regions; experience in farming and living in the area; farm size; and enterprise type (Barnes et al., 2011; Bohnet, 2008; Emtage and Herbohn, 2012). This research also included additional descriptors of membership of farmer/industry and Landcare groups, along with

experience of poor seasons to see if these were also definitive typological characteristics.

The list of demographic characteristics examined comprised:

- Males and females
- Age
- Farm/agribusiness participants and non-farmers
- Membership of industry and Landcare organisations
- Where participants lived/worked/farmed
- Farm size
- Time lived in a shire
- Time involved in farming
- Family history in farming
- Experience of poor seasons
- Frequency of poor seasons in 10 years

So who were 'Acceptors', 'Uncertains' and 'Sceptics' (Figure 7.3)?

There were no significant differences of characteristics between the clusters in regards to: gender; age; industry and Landcare group membership; where participants lived and farmed and the size of farms. Nor were there any significant differences between farm/agribusiness participants in the clusters as to being affected by poor seasons or frequency of poor seasons. Although there was a higher proportion of females in the 'Acceptors' cluster than the other two clusters, the 'Tamhame' Post Hoc Test undertaken because there was a non-normal variance distribution indicated that this was not a significant difference in this research. A figure describing these non-significant demographic characteristics is available in Appendix nine.

The lack of significant differences between gender and age differed from Australian research of around the same period which had shown young adults (18-28 years) and females tended to be concerned about climate change (McCrindle Research, 2008). In addition, the insignificant associations of region and property size did not concur with other Australian environmental social profiling studies (Bohnet, 2008; Emtage and Herbohn, 2012). This may have been due to the focus of these studies being on

land-use values of different types of landholders ranging from non-commercial lifestyle properties to small and large commercial enterprises. It may also been the result of strong social bonding and effective socialisation within and between farming families in the study regions

ANOVA and relevant Post Hoc Tests revealed proportionately more non-farmers being 'Acceptors' compared to 'Sceptics' (Figure 6.3). Additionally, 'Sceptics' were more likely to have lived in an area significantly longer than 'Acceptors' and spent more time in farming compared to 'Uncertains' and 'Acceptors'. Equally farming participants in the 'Sceptics' cluster had significantly more family history in farming than farmers in the 'Uncertain' and 'Acceptor' clusters.

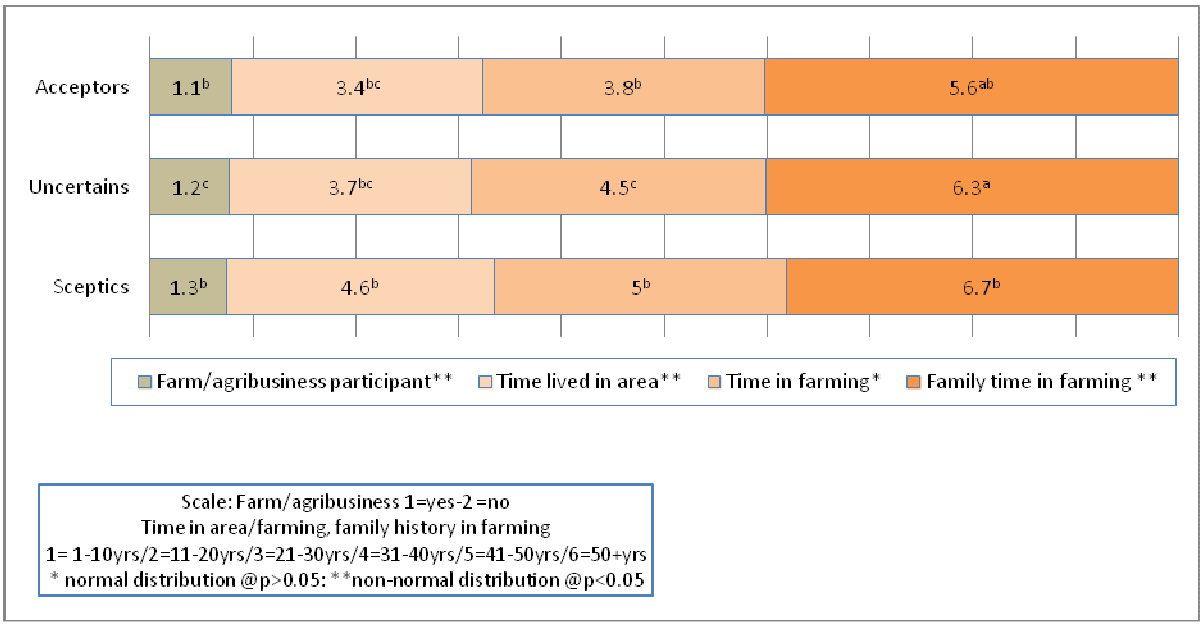

Figure 6.3 Significant characteristics of clusters

n='Acceptors' 38-74/'Uncertains'131-206/'Sceptics'49-62
a=99% confidence of statistically significant differences i.e. $p<0.01$
b=95% confidence of statistically significant differences i.e. $p < 0.05$
c=no statistically significant differences

Differentiation between clusters based on the extent of experience in living in an area and time involved in farming were similar to results of other farmer/landholder social profiling research undertaken in Australia (Bohnet, 2008; Emtage and Herbohn, 2012).

In summary, the multivariate analysis (PATN, 2.3; Belbin, 1993a) (Table 6.2) illustrated that 'Acceptors' shared primary value associations of: climate change acceptance; valuing science and scientific information and finding climate change information easy to understand. In addition, 'Acceptors' exhibited a low correlation of association with the variable: 'climate change is a natural climatic cycle…not influenced by greenhouse emissions'.

Conversely, the 'Sceptics' cluster was defined by associations that: 'Climate change was a natural climatic cycle…' and 'Science could not solve the climate change problem'. The 'Uncertains' cluster in turn exhibited a lack of confidence in the credibility and integrity of climate change science but at the same time was not sure if: 'Climate change was a natural climatic cycle'. Unlike the 'Acceptors' cluster, 'Sceptics' and 'Uncertains' clusters indicated a low correlation in finding climate change information easy to understand.

In addition, an underpinning element of difference between the clusters included the characteristics of time lived in area and being involved in farming and family farming history, which suggested a contingent relationship between extent of experience and attitudes to climate change and climate change science. The higher percentage of more experienced farmers in the 'Sceptics' cluster and their responses to science suggested, as Holloway (1999) had proposed, tensions between 'Sceptics' farmers knowledge/experience of climates and scientific climate knowledge. To examine the significance of this relationship the research examined in more detail 'Acceptors', 'Uncertains' and 'Sceptics' responses to climate change being a natural climatic cycle, the value of climate science information and understanding climate change information.

6.5 'Acceptors', 'Uncertains' and 'Sceptics' intrinsic climate change and science values

As this was exploratory research, layers of analyses based on cumulative knowledge were used to more fully develop an understanding of associations of intrinsic values within the clusters and differences in intrinsic values between the clusters. To begin with the research examined clusters if climate change was viewed as a voluntary (caused by humans) or involuntary (natural causes) threat/risk. Research had shown people were more likely to take action to minimise risk related to human activities

than risk related to natural causes, which was generally regarded as inevitable (Finucane, 2000).

Most 'Acceptors' viewed climate change as a voluntary activity, whereas 'Sceptics' largely thought it an involuntary activity (Figure 7.5). Of note was that no 'Acceptors' strongly agreed or agreed climate change was natural.

- 'Climate change is a natural climatic cycle and not influenced by greenhouse emissions'
  - 63% of 'Acceptors' strongly disagreed or disagreed
  - 38% of 'Uncertains' strongly agreed or agreed
  - 64% of 'Sceptics' strongly agreed or agreed

The research then assessed if the typologies were conceptualising threat/risk within socio-cultural contexts and/or familiarity with variability in the climate which research had shown could reduce people's acceptance of 'expert' opinions and lead to tensions between local informal knowledge and 'expert' knowledge (Covello and Johnson, 1987; Fleming and Vanclay, 2009; Holloway, 1999; Sjoberg, 2001).

Almost three quarters (72%) of 'Acceptors' who generally had less experience of living in an area and farming than 'Uncertains' and 'Sceptics' believed scientists ('expert') climate change information was useful (Figure 6.4). This was more than double that of 'Uncertains' (35%) and 'Sceptics' (33%). Also of interest was that no 'Acceptors' strongly disagreed or disagreed science climate information was useful.

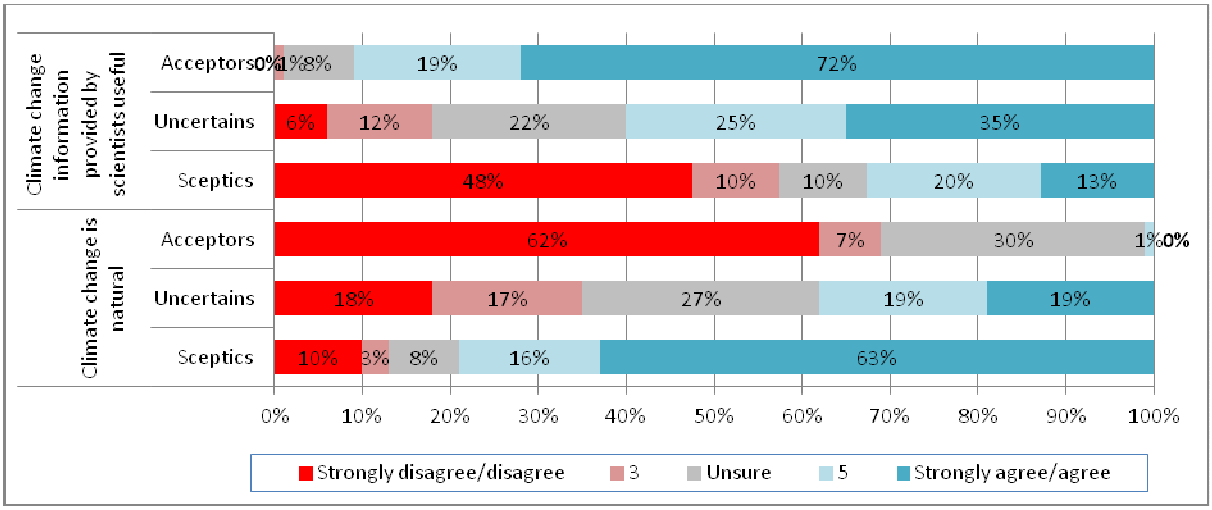

Figure 6.4 Cluster values: Climate change natural; science information useful
n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62

In turn 61% of 'Acceptors' believed the information was easy to understand compared to only 32% of 'Uncertains' and 29% of 'Sceptics' (Figure 6.5):

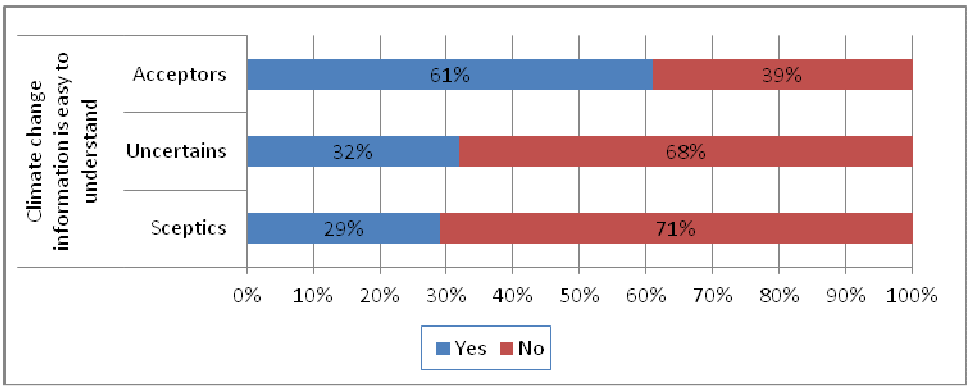

Figure 6.5 Understanding climate change information

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62

ANOVA and appropriate test procedures were used check significances of difference and which questions were significantly different between the clusters.

'Acceptors' were more likely to not believe climate change was a natural climatic cycle whereas 'Sceptics' were while 'Uncertains' were unsure (Figure 6.6). In addition, 'Acceptors' believed climate change information provided by scientists was useful while 'Uncertains' thought it was somewhat useful and 'Sceptics' considered the information less useful. Additionally 'Acceptors' were more likely to find climate change information easy to understand than 'Uncertains' and 'Sceptics' participants.

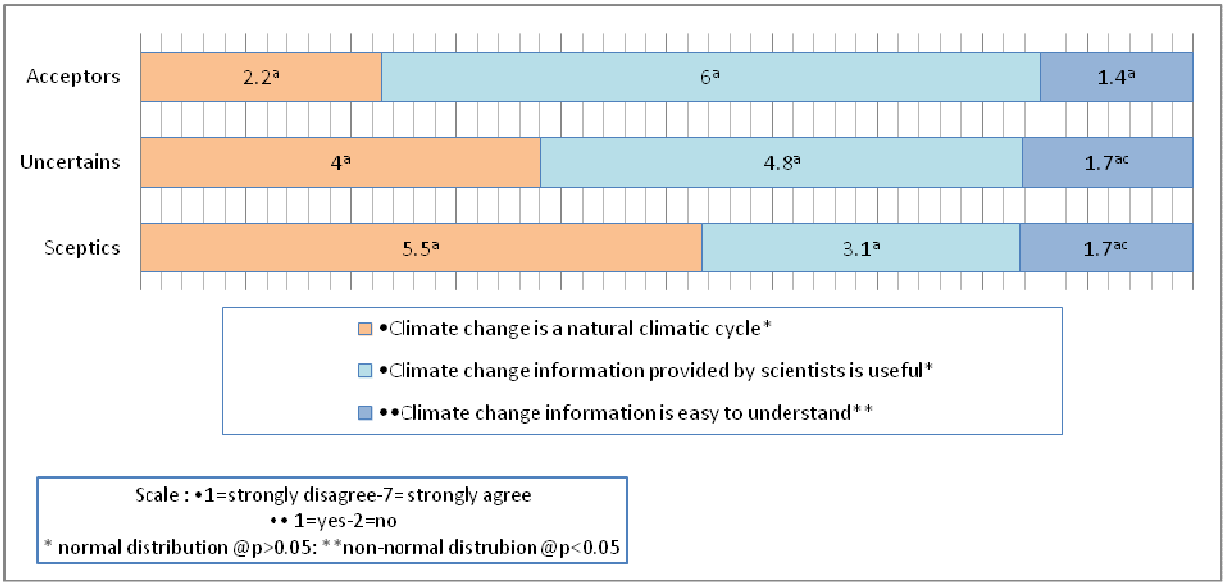

Figure 6.6 Cluster climate change and science information values

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. $p<0.01$
c=no statistically significant differences

These results suggested as other studies had that familiarity derived from experience within socio-cultural contexts was contributing to some significantly core differences between the clusters (Figure 6.7) (Covello and Johnson, 1987; Fleming and Vanclay, 2009; Holloway, 1999; Sjoberg, 2001). The 'Acceptors' with less experience were more likely to view climate change as a voluntary activity and were more receptive to scientific (expert) information which did not necessarily conflict with their local knowledge forms. 'Sceptics' on the other hand, with more extensive experience of climatic variability which had led to a greater familiarity with climate risk tended think climate change was a natural cycle which conflicted with science's information. Uncertains being unsure if climate change was a natural climatic cycle were a little more receptive to science's information.

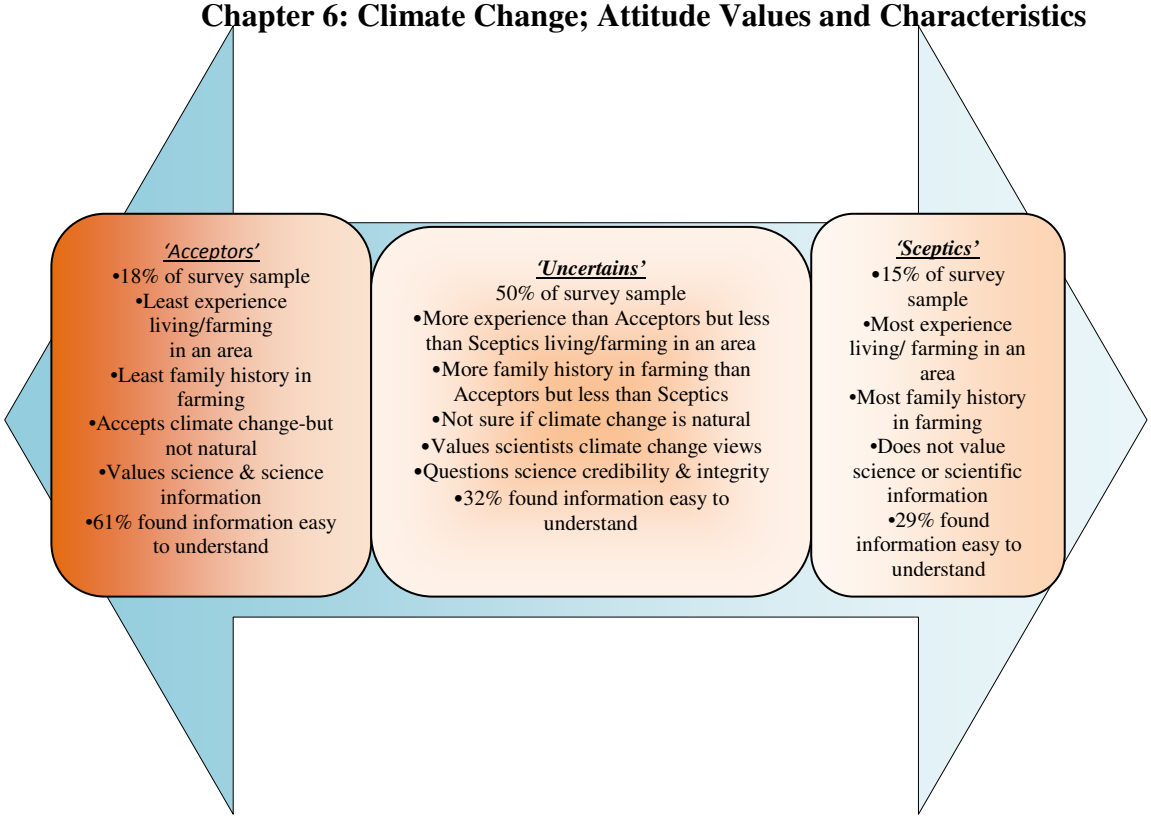

Figure 6.7 Core cluster characteristics and values

Having established that 'Acceptors' generally value science, 'Uncertains' somewhat value science and 'Sceptics' ascribe little value to science, the research then examined what was contributing to these values. A primary issue investigated in other research was the element of relevance and what the public/farmers perceived as salient. This often differed from what science thought was important (Cash et al., 2002; Garvin, 2001; Holloway, 1999; Margolis, 1996).

6.6 Credibility of science and science information

Generally, it had been found that the extent of experience of previous climate events and eventual outcomes influences public perceptions of sciences' risk information (Adeola, 2009; Langford, 2002; Nicholls, 1999). Given the difference in extent of experience between 'Acceptors', 'Uncertains' and 'Sceptics', the research compared responses of the clusters to questions related to the integrity of scientists and the credibility of sciences climate information (Figures 6.8 and 6.9).

'Acceptors' were convinced and 'Uncertains' positive that science and agriculture/rural communities should cooperate to find climate change solutions, compared to 'Sceptics' who were only somewhat inclined to agree (Figure 6.9). In

turn, 'Sceptics' were also more likely to believe 'Scientific estimates of climate change had not taken all factors into account' in contrast to 'Uncertains' who were less sure and 'Acceptors' who tended to disagree. 'Sceptics' were also sure that 'Science was exaggerating potential impacts of climate change', whereas 'Uncertains' were not as sure and 'Acceptors' more likely to disagree. Similarly, 'Sceptics' were certain 'Science was divided about what was causing climate change to happen faster', unlike 'Uncertains' who were somewhat sure and 'Acceptors' who were less certain. Equally, 'Sceptics' were certain 'Climate change was the latest fashionable funding source for scientists/researchers' compared to 'Uncertains' who thought it might be and 'Acceptors' who were relatively sure it was not.

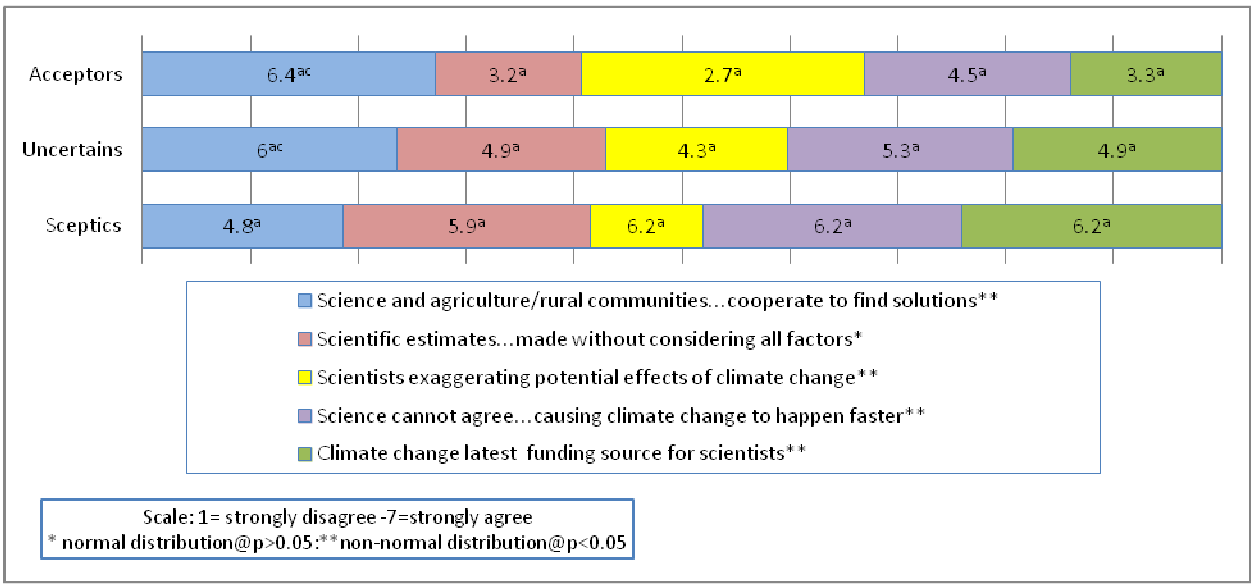

Figure 6.8 Clusters' intrinsic science values

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01
c=no statistically significant differences

'Sceptics' were also more likely to think that 'The ordinary person would contribute as much to climate change solutions as scientists' whereas 'Uncertains' were not as convinced and 'Acceptors' were unsure (Figure 6.9). Likewise 'Sceptics' were also quite confident 'Science could not solve the climate change problem' as opposed to 'Uncertains' who were inclined to disagree and 'Acceptors' who were more likely to disagree). In addition 'Sceptics' were in little doubt 'Humans would adapt naturally as the climate changed' while 'Uncertains' were less convinced and 'Acceptors' disagreed.

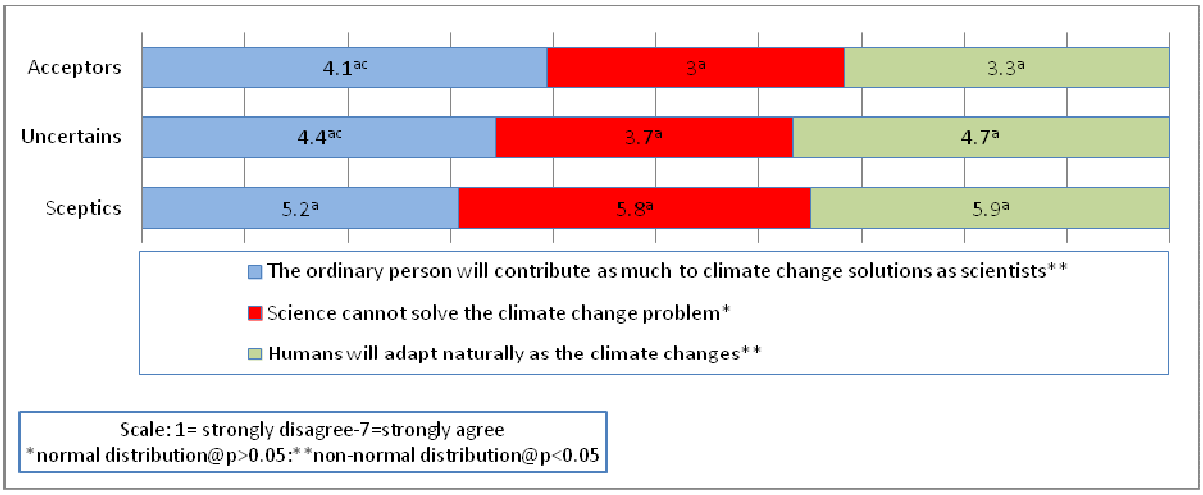

Figure 6.9 Clusters' intrinsic science values

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01
c=no statistically significant differences

6.6.1 Questions of validity and relevance of scientific knowledge

The intrinsic differences in values displayed by each cluster to specific questions of integrity and credibility of climate change science and information were reflected in responses to broader values of science and scientific climate change information sources (Figure 6.10).

'Acceptors' highly valued and 'Uncertains' valued: 'climate change views and opinions of scientists' in contrast to 'Sceptics' who considered scientists' views of little value. Science publications were also considered an important source for climate change information by 'Acceptors' but 'Uncertains' ascribed little importance and 'Sceptics' who attributed almost no importance to these publications.

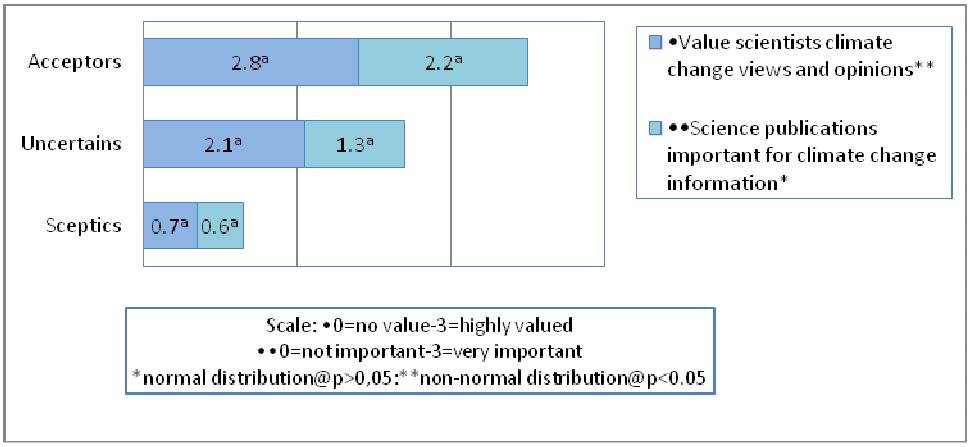

Figure 6.10 Cluster values of scientists and science publications

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01

These results further demonstrate the relationship between extent of experience and development of local knowledge forms with participant's perceptions of science's credibility and value of its climate change information. Acceptors were more likely to be favourably predisposed to science and accept climate science as credible. In contrast Sceptics viewed science much less favourably and credible. For the most part Uncertains predisposition to climate science lay somewhere between Acceptors and Sceptics. The factors: 'Climate change threat' and 'Climate change scepticism' extracted from the PCA (Table 6.2) had indicated associations between perceptions of climate change threat, valuing science, and local knowledge linking local climate activity to climate change. To further explore these associations and if heuristic functions such as availability, anchoring and adjustment underpinned predictive assessments of climate activity the research compared responses between the clusters to observed changes in climate and implications of the changes.

6.6.2 Influence of local knowledge

Most 'Acceptors' had noticed that 'rainfall had decreased'…'quite a bit' in the previous 10 years compared to 'Uncertains' and 'Sceptics' who had noticed some decrease (Figure 6.11). Equally 'Acceptors' had also noticed 'quite a bit' of 'increased variability in seasons', whereas 'Uncertains' had noticed some increase and 'Sceptics' a little increase. Likewise 'Acceptors' thought there had been 'quite a bit' of an increase in 'extreme weather events', in contrast to 'Uncertains' who there had been less increase and 'Sceptics' who thought there had not been much increase.

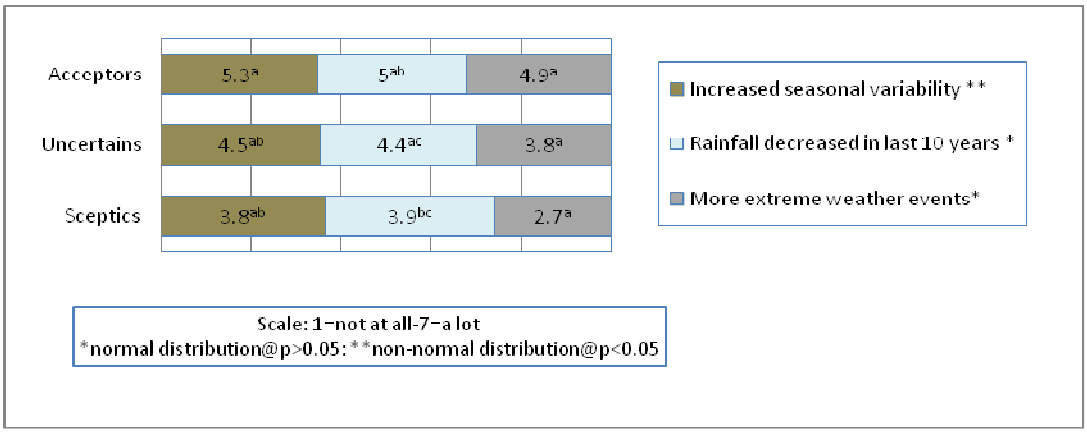

Figure 6.11 Cluster values of observed changes in climate

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01
b=95% confidence of statistically significant differences i.e. p < 0.05
c=no statistically significant differences

'Acceptors' were also more inclined to believe 'poor seasons and extreme weather events were linked to climate change' as opposed to 'Uncertains' who were less sure and 'Sceptics' who more likely not to agree (Figure 6.12). Despite 'Acceptors' responses to poor seasons and extreme weather events being linked to climate change, they also somewhat agreed that 'poor seasons and seasonal variability were part of living/farming in rural areas'. However unlike 'Acceptors', 'Sceptics' and 'Uncertains' were more confident that 'poor seasons and seasonal variability were part of living/farming in rural areas'.

Of note were responses to the statement: 'There have been worse seasons and droughts than the ones that have just happened' (Figure 6.12). 'Acceptors' were not quite sure if there had been worse seasons and droughts before, whereas 'Sceptics' and 'Uncertains' were relatively sure there had been. However, 'Tamhame' Post Hoc tests used because there was a non-normal distribution showed that although 'Acceptors' responses were significantly different (P<0.05) to 'Uncertains' responses, there was no significances of difference with 'Sceptics' responses.

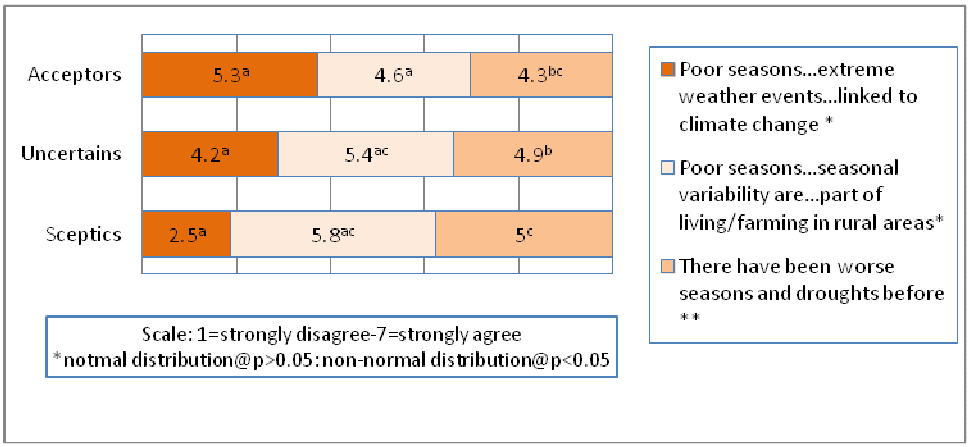

Figure 6.12 Value clusters assessments of implications of changes in climate

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01
b=95% confidence of statistically significant differences i.e. p < 0.05
c=no statistically significant differences

The heuristic functions of availability, anchoring and adjustment were present among participants in each of the clusters but Sceptics offered the clearest example. As the cluster with the most extensive experience in an area and farming, they mainly thought there had been worse seasons and droughts before than the ones that had most recently occurred.

In making that assessment many participants would verbally cite a particular event derived from their own experience or from family experience. For example more experienced farmers would nominate periods of drought during the mid-1970's, the mid 1940's and also quite commonly, the 'Federation' drought that had occurred in the very early 1900's. These events could be said to have a high 'availability' for the individual concerned. As such it could be argued that these events acted in an 'anchoring' fashion in that they essentially had become a benchmark of the period of the 'worst' poor seasons.

The 'adjustment' function can be seen in Sceptics responses to the questions regarding observed changes in local climate and their predictive assessment of those changes. Sceptics felt that overall there had been little change in rainfall, seasonal variability and frequency of extreme weather events. Why? Because they may have been measuring and comparing the recent changes to past climatic periods and events they believed were far worse. So therefore it could be that Sceptics believed the climatic variations were a normal cycle because there had been more dire climatic periods in the past which had past and the climate had returned to 'normal'.

Acceptors who lacked the extensive base of experience would have had fewer if any worse past experiences to compare recent occurrences with, hence the inclination to equate recent changes in the climate with climate change.

Results of the PCA (Table 6.2) had shown interdependent associations between values of: climate change threat; climate change occurring and not being a natural climatic cycle; and local knowledge. The research examined values of climate change threat and farm/agribusiness participants' prioritisation of climate change to the economic viability of their businesses to determine the significance of climate change threat between the three clusters.

6.6.3 Threat and priority of climate change

Most 'Acceptors' believed 'Climate change was a major threat to the future of rural communities' compared to 'Uncertains' who were somewhat sure and unlike 'Sceptics' who tended to think climate change was not a threat to communities (Figure 6.13). Similarly, 'Acceptors' mostly viewed 'Climate change as a major threat to the future of their farms/businesses', while 'Uncertains' were less convinced and 'Sceptics' were inclined to think climate change posed little threat to their businesses.

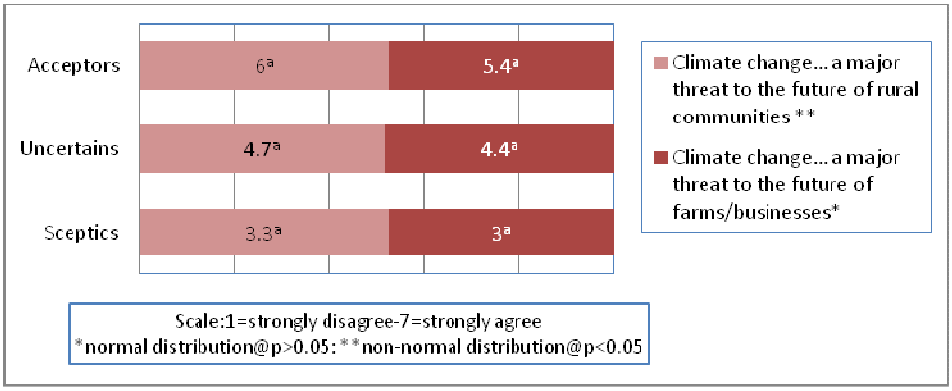

Figure 6.13 Climate change threat

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01

Studies had proposed that perception of threat/risk and the motivation to respond is defined within socio-cultural and personal values and belief frameworks (Covello and Johnson, 1987; Sjoberg, 2001). However, in the case of farmer's, earlier research found there was inclination to view climate change more as a benefit or opportunity rather than a threat which influenced how farmers responded (Dahal, 2006; Holloway, 1999; Pink, 2008).

'Acceptors' to a larger degree than Uncertains did not agree there was 'No need to respond to climate change', in contrast to 'Sceptics' who were inclined to agree (Figure 7.15). Additionally ,'Acceptors' along with 'Uncertains' did not think they would 'Wait and see if there was a need to respond to climate change' as opposed to 'Sceptics' who thought they would wait and see if there was a need to respond.

Both 'Acceptors' and 'Uncertains' were unsure if they wanted to 'Respond to climate change but were not sure how to', compared to 'Sceptics' who disagreed (Figure 6.14). However, 'Acceptors' were more confident that there was a need to

respond to climate change and that they were responding, unlike 'Uncertains' who were unsure and 'Sceptics' who tended to disagree.

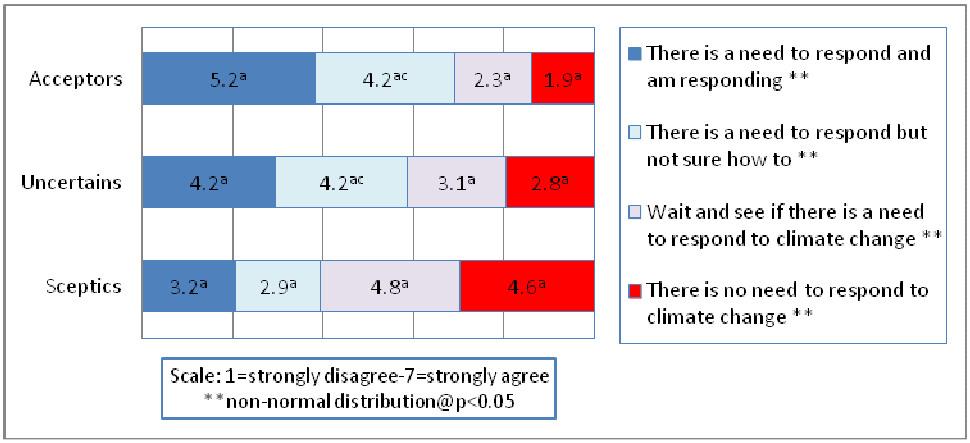

Figure 6.14 Responses to climate change threat

n='Acceptors'-74/'Uncertains'-207/'Sceptics'-62
a=99% confidence of statistically significant differences i.e. p<0.01
c=no statistically significant differences

Despite a high perception of climate change threat to their businesses, 'Acceptors' rated climate change the fourth most important influence to their businesses' economic sustainability in comparison to other costs, management issues and environmental sustainability (Figure 6.15). 'Acceptors' as with the other clusters considered fuel, fertiliser prices and environmental sustainability more important than climate change. However, 'Acceptors' rated climate change more important than chemical prices, interest rates and labour issues. Conversely, 'Uncertains' and 'Sceptics' rated climate change as least important influence on their businesses' economic sustainability.

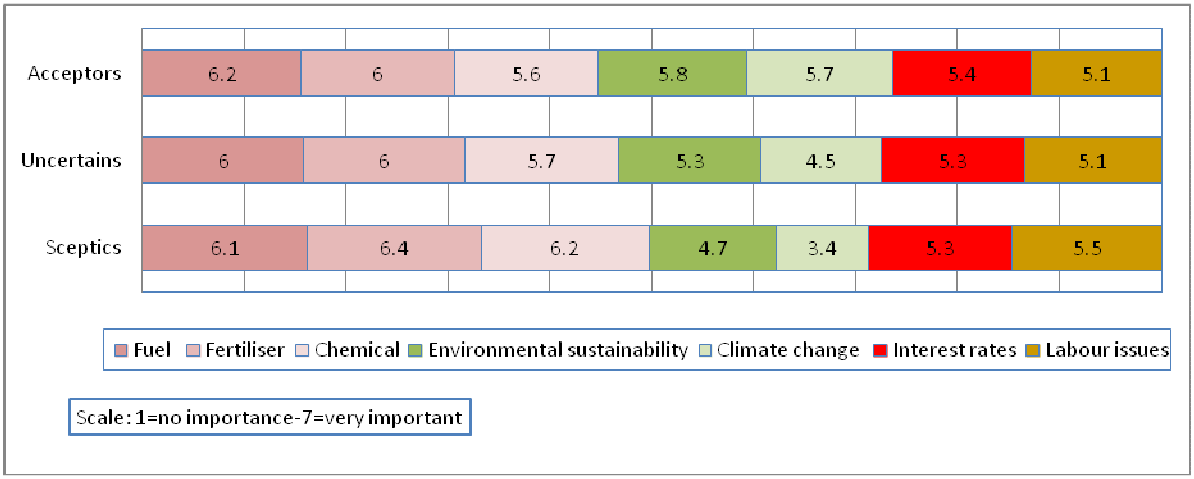

Figure 6.15 Cluster prioritisation of factors affecting business sustainability
n='Acceptors'48-74/'Uncertains'166-207/'Sceptics'57-62

'Acceptors' were more likely to regard climate change as an important influence on businesses' economic sustainability compared to 'Uncertains' and 'Sceptics' (Figure 6.16).

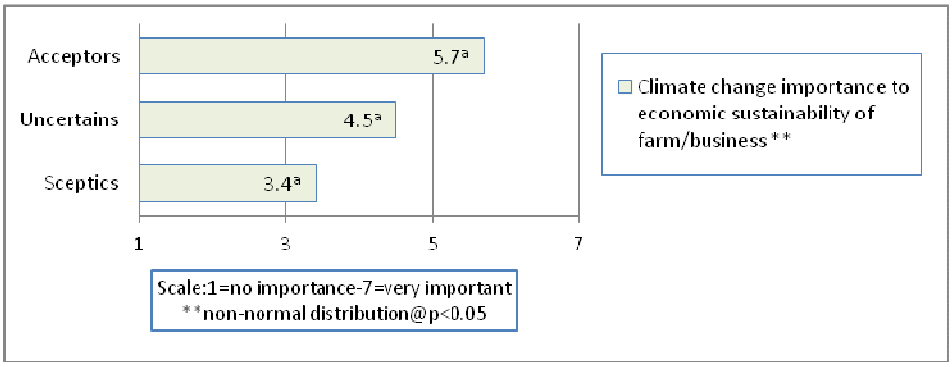

Figure 6.16 Importance of climate change to business sustainability
n='Acceptors'-48/'Uncertains'-166/'Sceptics'-57
a=99% confidence of statistically significant differences i.e. $p<0.01$

The results showed that environmental sustainability was the only other important influence on businesses' economic sustainability where there were differences between the clusters. During the Familiarisation study, the aboriginal participants exhibited beliefs and values of cultural connectedness to the environment. In turn, these beliefs and values influenced their perceptions of changes in climate and attitudes to climate change.

Other research indicated that empathetic cultural connectedness with the environment could shape pro-environmental values and behavioural attitudes (Dutcher et al., 2007), which in turn could be predictors of peoples' responses to climate change (Barr, 2007). To further explore this concept, analysis was undertaken to see if there were associations between the clusters and environmental values.

6.7 Environmental Values

'Acceptors' and 'Uncertains' rated environmental sustainability as significantly more important to business sustainability compared to 'Sceptics' (Figure 6.17).

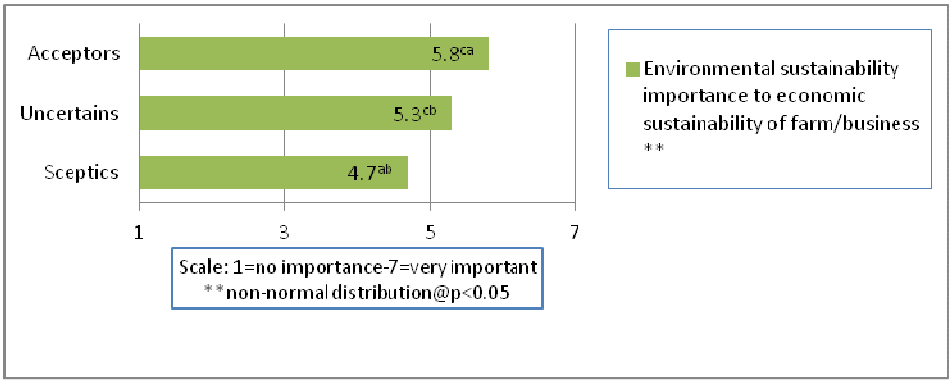

Figure 6.17 Environmental sustainability importance to business sustainability

n='Acceptors'-48/'Uncertains'-166/'Sceptics'-57
a=99% confidence of statistically significant differences i.e. p<0.01
b=95% confidence of statistically significant differences i.e. p < 0.05
c=no statistically significant differences

However, responses to: 'How much do you invest in long term environmental responses on the farm?' indicated most farmers in all the clusters had initiated a relativity high level of investment (See Appendix 10)

As to 'long term environmental investments in the home', 'Acceptors' and 'Uncertains' had initiated significantly more investment compared to 'Sceptics' who had made only some investment (Figure 6.18). 'Acceptors' had also initiated more 'long term environmental investment in their businesses', whereas 'Uncertains' had made some investment and 'Sceptics' had invested somewhat less.

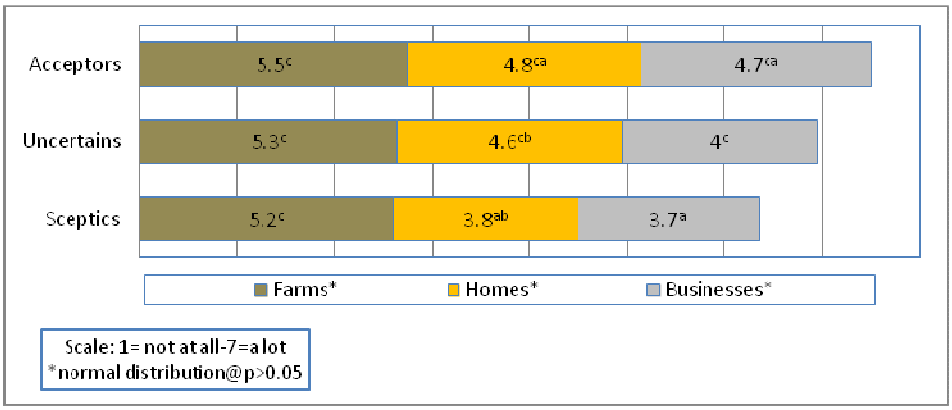

Figure 6.18 Levels of environmental investment in farms, businesses and homes

n='Acceptors' 43-73/'Uncertains' 134-196/'Sceptics' 47-46
a=99% confidence of statistically significant differences i.e. p<0.01
b=95% confidence of statistically significant differences i.e. p < 0.05
c=no statistically significant differences

6.8 Discussion

The results of this research have indicated distinctive differences in characteristics and climate change/climate change science values between three main clusters of participants. Results demonstrated that in terms of information/knowledge diffusion, 'one size does not fit all'. These outcomes provided an insight to why some segments of the WA rural population are more receptive to scientific knowledge/information and other segments are less accepting or sceptical. This illustrates the importance of understanding the 'market' in terms of segmenting the diffusion approach of climate change information.

The results indicate that the views of 'Sceptics', 'Acceptors' and 'Uncertains' regarding climate change are not based on an intransigence of unsubstantiated beliefs and values. Each cluster exhibited internal associations which were subject to what participants felt was valid knowledge. While farm/agribusiness participants in each cluster had similar experiences of poor seasons in the previous ten years and participants living in the same communities at the same time had experienced the same climate activity, each cluster had a different perspective of the situation.

There were four broadly-defining interdependent values which summarised differences between the clusters (Figure 6.19). These were: if climate change was natural or not; if it was a threat or not; the overall value and importance of sciences climate change information/knowledge; and whether agriculture/rural communities actually needed science to help them adapt to climate change. Underpinning these values was the characteristics of experience associated with the extent of experience of living in area or involvement in farming and family history in farming.

In addition there were also the characteristics of farmer/agribusiness participants and non farmers which factored as a difference between the Acceptor and Sceptic clusters. There were proportionately more farm/agribusiness participants in the 'Sceptics' cluster than the 'Uncertains' and 'Acceptors' clusters. Alternately, there were proportionately more non-farmers in the 'Acceptors' cluster compared to the 'Uncertains' and 'Sceptics' clusters. 'Sceptics' had lived in an area longer and had a more extensive family history in farming than 'Acceptors' and 'Uncertains', but 'Sceptics' and 'Uncertains' had significantly more experience in farming than 'Acceptor' farmers. These characteristics reflected some of the typological

differences observed in other Australian research (Bohnet, 2008; Emtage and Herbohn, 2012).

'Sceptics' views of climate activity could be derived from their extensive experience and the influence of the heuristic functions of availability, anchoring and adjustment. In addition Sceptics views may also be influenced by what Stedman (2003) described as a memory lag between the perception of what had been and the reality of what was. There is also remains the possibility that 'Sceptics', and for that matter 'Uncertains' and 'Acceptors', recollections of past climatic events were rendered somewhat less reliable due to duration and/or frequency and/or stress related to the experience (McLeod, 2009; Morgan[III] et al., 2004; Sutton, 2010).

In broad terms, 'Acceptors' were at the opposite end of the spectrum to 'Sceptics' and 'Uncertains' occupied a range of the space between (Figure 6.19). While there was a clear definitive separation of 'Acceptors' and 'Sceptics' values, 'Uncertains' position was at times a little fluid. In some instances 'Uncertains' shared similar attributes with 'Acceptors', such as uncertainty of 'the ordinary person contributing as much to climate change solutions as scientists' and the need for '…science to work…with the agricultural industry…rural communities to find climate change solutions'. In other instances, particularly in relation to local climate knowledge of 'rainfall decrease' in the previous 10 years and 'poor seasons and seasonal variability…part of living/farming in rural areas', the views of 'Uncertains' were closer to those of 'Sceptics'. However, 'Uncertains' position was for the most part statistically definitive.

'Acceptors' were unequivocal that climate change was not a natural climatic cycle and was a threat that needed to be responded to. The Tasmanian research of Fleming and Vanclay (2009) had also found that farmers who believed climate change was human-induced, thought it important to take actions to alleviate causes. 'Acceptors' belief climate change was not natural seemed as Finucane (2000) proposed, could have a major bearing on their perceptions of threat/risk. This suggests that 'Acceptors' view that climate change was the result of human activity (voluntary) required action to minimise a threat/risk. Conversely 'Sceptics' belief climate change was part of a natural climatic process (involuntary) meant that they saw the

threat/risk as being inevitable and would its course irrespective of actions taken. In essence this reflects the fatalistic approach described by Langford (2002) as;

"…the externally orientated belief that life is largely a matter of chance and there is little humans can do to alter its course."

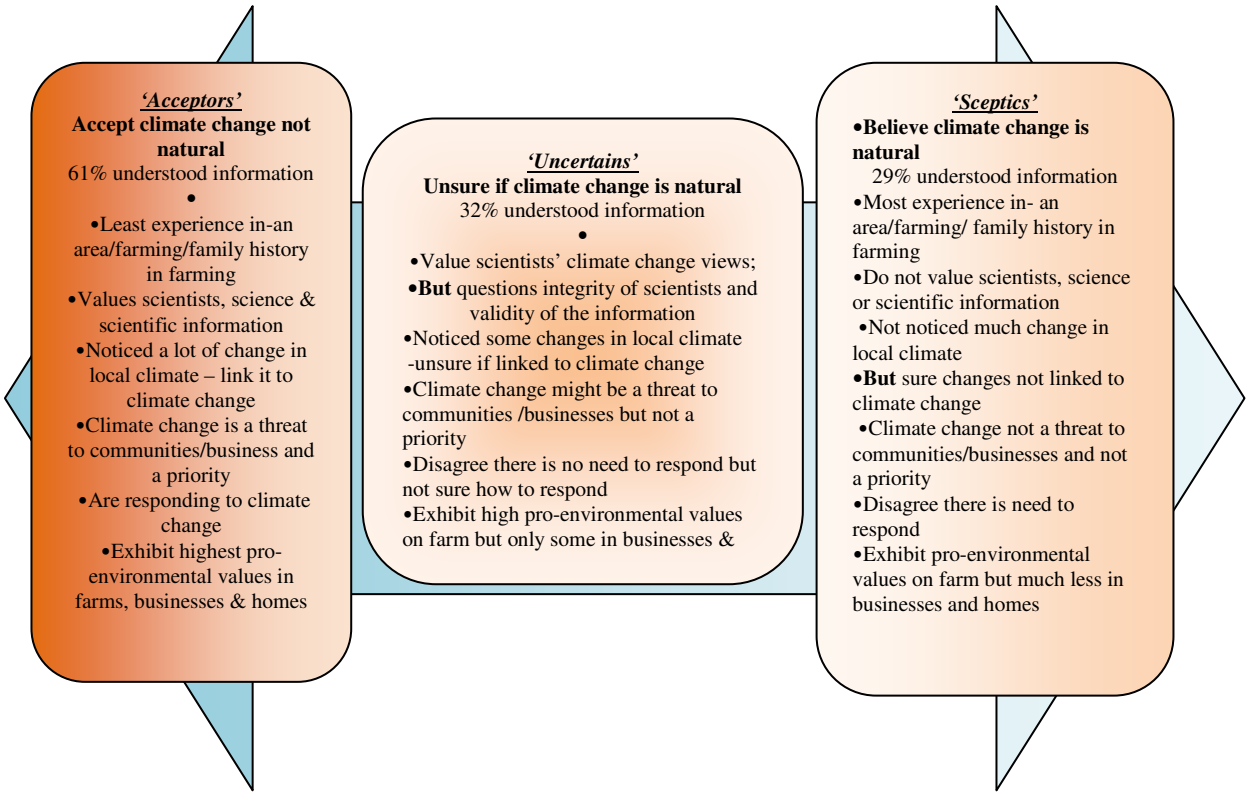

Figure 6.19 Typological characteristics of the clusters

Unlike other typology studies there were no definitive differences between the clusters based on where participants farmed or farm sizes (Barnes et al., 2011; Bohnet, 2008; Emtage and Herbohn, 2012). Experiences of poor seasons, membership of industry/grower groups and/or Landcare groups were also not shown to be defining characteristics of the clusters.

Although 'Acceptors' believed climate change information provided by scientists was useful and the cluster generally attributed a high value to science, there was still some tensions evident between their local knowledge and science's. Apart from 'Acceptors' concerns that science was divided about what was causing the climate to

change faster, there was a notable conflict between what climate activity was perceived as linked to climate change and what was considered normal. Whereas 'Acceptors' had noticed the most changes in local climate and assessed poor seasons and extreme weather events as being most likely linked to climate change (mean 5.3), they were also inclined to think poor seasons and seasonal variability were a normal part of living/farming in rural WA (mean 4.6). Although these responses were not significant, they do indicate tensions for 'Acceptors' between what could be termed a socio-cultural construct of knowledge and scientific knowledge.

It could be said that science's low credibility with 'Sceptics' reflected the 'epistemological' distances between they viewed as important and science defined as important that Garvin (2001) described. These differences, as Cash et al. (2002) had shown, were derived from disparity between what Sceptics and scientists thought were points of relevance and salience.

This may have been a major contributing influence to why 'Sceptics' did not value science knowledge and information. However responses of 'Uncertains' who thought the information might be useful but were not sure mirrored earlier international (Anable et al., 2006; EORG, 2002; Maibach et al., 2009) and Australian (Bulkeley, 2000) research which showed concern about climate change was limited both by the information provided and what the public thought was important.

It could be proposed that the elements of relevance and salience were in part derived from the environmental values of each typology. In broad terms, there were higher level of pro-environmental values among 'Acceptors' compared to 'Uncertains' and 'Sceptics' based on environmental investments undertaken in businesses and homes. The inferred value associations between environmental sustainability and climate change in different clusters were of interest. It had been proposed there were interdependent relationships between pro-environmental values/behaviours and climate change values (Barr, 2007) and that previous pro-environmental behaviours (of landholders) could act as predictors of future actions (Ajzen, 1991).

However, there were no significant differences between farmers in each cluster in the high levels of environmental investments undertaken on farms. This concurs with Vanclay's (2004) observation that farmers consider environmental management as wholly integrated in farm/business management processes.

What was of interest was 'Acceptor' farmers ranking the importance of environmental sustainability almost equal with climate change (mean difference 0.1) but ranking the economic importance to their businesses sustainability of long term environmental/climate concerns second to the short term imperatives of fuel and fertiliser prices. While in the context of this research it may have been expected that 'Acceptors' would rate climate change as a primary priority their responses were not dissimilar to those concerned about climate change in other research (Anable et al., 2006; Dunlap and Saad, 2001; Maibach et al., 2009).

Overall, the results demonstrated that knowledge about climate change generated through scientific information and perceptions of threat played a minor part in influencing attitudes to climate change. A complex set of multiple interdependent values derived from socio-cultural contexts contributed to forming participants' attitudes to climate change and climate change science. Essentially, attitudes to climate change and climate change science were interrelated and the perceived legitimacy of climate change science and accepted knowledge was based on the extent of participants' local knowledge and experience.

It is important for scientists and policy makers to recognise that farmers and rural communities' 'knowledge' of changing climates and/or climate change is derived directly from experience of farming and living with climate variability and risk. As Holloway (1999) contends, this is a form of legitimate knowledge and irrespective of the knowledge holder's climate change views should not be dismissed as less valid than scientific knowledge.

Science as a generator and communicator of climate change information/knowledge also has an integrated consultative role in climate change governance in developing adaptation and mitigation policy. Studies have indicated that governments could face difficulties in regards to how the public perceive their actions and agendas in implementing policies (Botterill and Mazur, 2004; Cash et al., 2002; Garvin, 2001). Additionally, some research has raised concerns that proposed mitigation policies may have an adverse economic impact on Australian farmers and the agricultural industry (Keogh, 2011). The following chapter (Chapter 7) presents results and discussions of participants' responses to the role of government in climate change.

Chapter 7: Rural Climate Change Governance; Questions of Relevance, Trust and Credibility

7.1 Chapter Outline

Research contends that climate change governance will be fraught with tensions derived from conflict between what policy makers and the public believe are important issues, challenging government implementation of mitigation and adaptation policies (Bord et al., 1999; Cash et al., 2002; Lorenzoni and Langford, 2001).

This chapter examines responses of 'Acceptors', 'Uncertains' and 'Sceptics' to the role of government in climate change. This involves an evaluation of factors affecting these responses, derived from Factor analysis (Section 7.3) and comparisons of responses to government's potential international and national policy responses to climate change and climate risk (Section 7.4). The chapter concludes with a discussion of results and implications for climate change governance in rural areas (Section 7.5).

7.2 Perceptions and attitudes to government's policy responses to climate change

Climate change governance represents a "wicked" problem in its own right for governments and policy advisers. Earlier research proposed that governments could encounter serious challenges in developing and implementing national and international climate change policies in regards to how the public perceived their actions and agendas (Bord et al., 1999; Botterill and Mazur, 2004; Garvin, 2001; Lorenzoni and Langford, 2001Stoll-Kleemann et al., 2001). It is suggested this will increase challenges for government in maintaining public trust and credibility with the public (Adger et al., 2008) and politicise the public's perceptions of policy (Maibach et al., 2009). Furthermore it is proposed governments will be challenged as policies expose tensions in maintaining the diversity and options of adaptive and mitigation needs across the socio-cultural scope at local, state, national and international levels (Adger et al., 2008). Australian studies suggest farming/rural

communities could be adversely affected economically (Keogh, 2011) and may view proposed policy as a threat to livelihoods (Fleming and Vanclay, 2009).

Having identified three definitive rural climate change typologies, this research has the opportunity to investigate if perceptions of the role of government in climate change are influenced by particular climate change views in rural WA. To begin with, a Factor analysis was used to evaluate the interdependent associations between responses to the role of government in climate change and government's policy responses to climate risk.

7.3 Factor analysis and reliability scaling of responses to government's role in climate change

As well as using Factor analysis to explore interdependent relationships between questions, it was also used in this research to test some survey questions that had been developed for the first time as part of the exploratory process. This analysis tested responses to six statements concerning government's role in climate change and five statements related to the exceptional circumstances (EC) of government assistance criteria to see if interdependent relationships were present. If responses to individual variable questions were shown to be similar, ensuing research could be undertaken using fewer questions.

7.3.1 Principle Component Analysis of governments role in climate change

A Kaiser, Meyer and Olkin measure of sampling adequacy of 0.70 indicated the Factor analysis of science and government credibility variables were mediocre (Chi-square 430.788, df 55, $P < 0.01$).

Principal Component Analysis (PCA) extracted three factors with Eigen values greater than one that described 49% of the variance in responses. Although 49% of the variance is acceptable for exploratory research such as this, a variance of 60% is required for conclusive results. A variance under 60% indicates other unidentified factors may also have affected interdependent associations. As such, the results of the Factor analysis should be viewed as a partial explanation of interdependent relationships between responses. Of the three factors, two proved to be sufficiently

robust for exploratory research of this nature with a Cronbach's alpha score greater than 0.6 (Hair et al., 1998) (Table 7.1).

Table 7.1 Principal components of responses to Government's role in climate change

*variable reversed to give a positive score

Rotated Component Matrix[a]			
	Component/Factor		
	1	**2**	**3**
Factor: 'Governance concerns'			
Government…considering policy responses without taking all factors into account	0.78		
Reducing Australia's emissions without similar action from…rest of the world will be useless…responding…climate change	0.67		
Government policy will be fair…sensitive to…needs of agriculture…rural communities*	-0.63		
Politicians will use climate change as an election issue	0.61		
Including agriculture in…Carbon Trading Scheme by 2015 may reduce agricultures competitiveness in world markets	0.40		
Factor: 'Policy relevance'			
Exceptional Circumstances Declaration process should be simplified		0.8	
Criteria for Exceptional Circumstances should be relevant to WA farming conditions…farmers/rural business needs		0.69	
Drought assistance should be delivered on an individual basis without… Exceptional Circumstances declaration for a region		0.67	
More assistance needed to exit the industry where necessary		0.55	
Factor: 'Government support'			
Farms or business should run down their equity in assets before being provided with Exceptional Circumstances assistance*			-0.74
Government should significantly increase funding of agricultural climate change adaptation research			0.69
Factor Mean	15.5	11.1	10.4
Eigenvalue	2.6	1.7	1.2
Percentage Variance (%)	23.2	15.5	10.8
Cumulative Variance 49.4 %			
Cronbach's Alpha	0.66	0.68	0.37

Extraction Method: PCA, Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 5 iterations.

The PCA drew out three factors related to issues of climate change governance, policy relevance and government support. Reliability testing indicated two factors were sufficiently robust for exploratory research such as this.

7.3.2 Reliability testing

Factor 1: 'Governance concerns'

Factor one: 'Governance concerns' encompassed issues of concerns that government was not taking all factors into account during policy development (Table 8.3). This factor also included issues of policy fairness to the rural sector and issues of equity in policies undermining agriculture's competiveness in international markets. The question of whether 'Government policy will be fair and sensitive to the needs of agriculture and rural communities' was reversed to undertake reliability scaling. Its initial value was negative, indicating a reversal of the response to read as: 'Government will not be fair sensitive to the needs of agriculture and rural communities'.

The final element was an issue of trust that politicians would not politicise climate change. The issue of reducing Australia's emissions without similar action from the rest of the world loaded in the factor and factor reliability was sufficient (Alpha 0.65). However, omitting the variable increased the Cronbach's Alpha to 0.66 which was sufficiently reliable for exploratory research such as this (Hair et al., 1998). Thus the emissions reduction question could be used in future research as a single variable question.

Factor 2: 'Policy relevance'

Factor two: 'Policy relevance', comprised issues associated with the relevancy of criteria and application of Exceptional Circumstances (EC) assistance and a need to provide more support for farmers exiting the industry. The associations between the variables in this factor suggested concern of the relevance of EC criteria may have been underpinning concerns that agriculture and rural communities' needs might not be a priority for policy when developing and implementing climate change policies. Reliability scaling of the factor produced a Cronbach's Alpha of 0.63, which again was sufficiently robust for exploratory research such as this (Hair et al., 1998).

Factor 3: 'Government support'

Factor three; 'Government support' was a two variable factor that did not appear to be a good a fit (Table 8.3). The variable: 'Farms or business should run

down…equity in assets before being provided…Exceptional Circumstances assistance' addressed the issue of businesses using asset equity before being eligible for EC assistance. This variable was loaded with a negative value in the extraction, indicating that the meaning of the variable was reversed.

The second variable: 'Government should significantly increase funding of agricultural climate change adaptation research' was associated with government funding of climate change research. Each variable was associated with two different elements of government policy; one element being EC eligibility criteria, and the other increased financial support for agricultural climate change research. A Cronbach's Alpha of just 0.31 confirmed the factor was not sufficiently robust. The lack of fit between the variables and an insufficient 'Alpha' score indicated both variables should be used as separate single questions in any future research.

The two factors 'Governance concerns' and 'Policy relevance' underlined key issues that could represent challenges for government in developing and promoting climate change policies in rural areas. The results portrayed what a United States study described as a potential dichotomy between government 'experts" measured analysis of what was important in terms of policy approaches and what the public believed was important (Brody, Zahran, Vedlitz and Grover, 2008). The result of this dichotomy could effectively distance and disengage the public from the being part of the risk discourse and development of solutions.

The research undertook comparison analysis of responses to what participants believed was important in policy addressing issues of climate risk and extreme climate events through investigating differences between what 'Acceptors', 'Uncertains' and 'Sceptics',.

7.4 Clusters' perceptions of government's role in climate change

The responses of 'Acceptors', 'Uncertains' and 'Sceptics' were of particular interest in relation to differences between the clusters of: 1) climate change being considered human-induced and a major threat which need to be responded to; 2) uncertainty that climate change was natural or not and could be a threat to which some response

might be necessary; 3) climate change was natural and not a threat which required any response.

The main questions for the research were: Would responses of 'Acceptors' support government's proposed approaches to facilitating climate change solutions; what were 'Uncertains' views; and would 'Sceptics' display unfavourable values in relation to government's climate change roles? Research conducted in the USA research had indicated that climate change was viewed as human-induced and a threat there was more advocacy for government to mitigate potential outcomes and promote adaptive behaviours (Maibach et al., 2009).

7.4.1 Clusters: Value of Government's role in climate change solutions

Comparison of responses was undertaken using ANOVA and 'Sidak' Post Hoc Tests to check significances of difference if distribution was normal.

There were no statistically significant differences between the three typologies concerning government increasing agricultural climate change adaptation research and politicians using climate change as an election issue (Figure 7.1) (Detailed responses of participants to specific statements are available in Appendix 11).

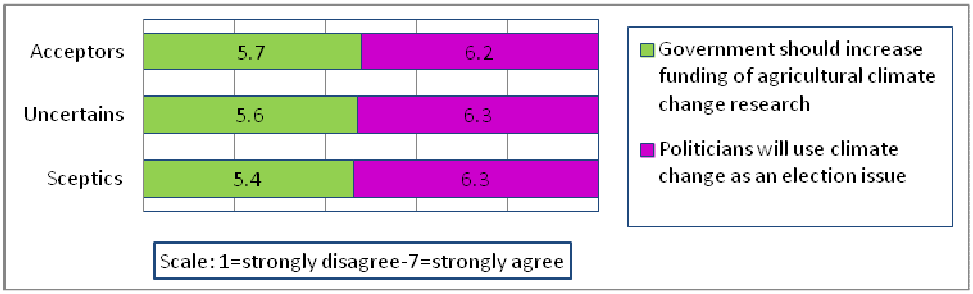

Figure 7.1 Policy and trust concerns

There were, however, significant differences between responses of the clusters to the remaining four questions concerning policy approaches (Figure 7.2). 'Sceptics' believed that reducing Australia's emissions without similar action from the rest of the world would be useless in responding to climate change while 'Uncertains' were also inclined to agree. Of interest 'Acceptors' somewhat agreed with the statement

but did not disagree. 'Sceptics' were also surer that government was not taking all factors into account compared to 'Uncertains' and 'Acceptors'.

The statement: 'Including agriculture in the carbon trading scheme by 2015 may reduce agriculture's competitiveness in world markets' drew mixed responses (Figure 7.2). 'Sceptics' and 'Uncertains' were more inclined to somewhat accept that the inclusion of agriculture in a carbon trading scheme would reduce Australian agriculture's international competiveness. In comparison 'Acceptors' were not as sure if a future carbon trading scheme would impact on agriculture's international competitiveness . Alternately 'Sceptics' more strongly disagreed that: 'Government policy would be fair and sensitive to the needs of agriculture and rural communities' than 'Uncertains' and 'Acceptors'.

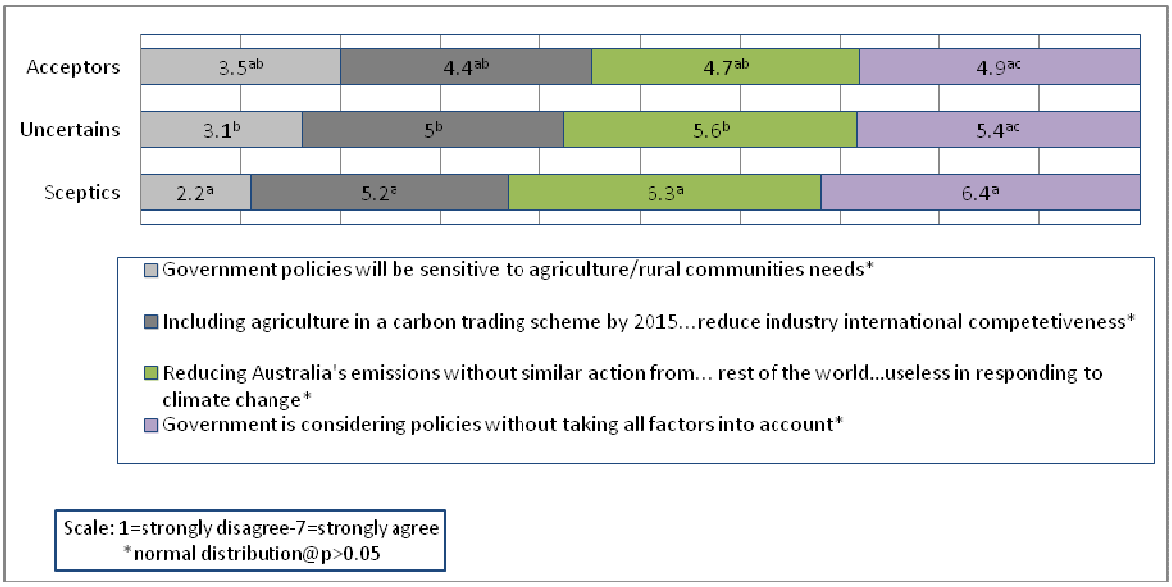

Figure 7.2 Cluster values: Concern for policy impacts on the rural sector

'Acceptors' n=72-73; 'Uncertains' n=203-204; 'Sceptics' n=60-61
a = 99% confidence of statistically significant differences i.e. $p<0.01$
b = 95% confidence of statistically significant differences i.e. $p < 0.05$
c = no statistically significant differences

Although there were significant differences between the clusters, unlike Maibach et al.'s (2009) study which showed that acceptors of human-induced climate change were more likely to support affirmative government policies, responses of 'Acceptors' in this research were somewhat more circumspect. They did not support an emission reduction policy without similar responses from the international

community and they were inclined to think government had not considered all relevant factors in considering policy. Given that Acceptors were the most receptive to addressing climate change threats; these responses represent potential challenges for government.

Likewise challenges governments face in implementing climate change policies was reflected in the value attached to the views of climate change policy 'experts' (Figure 7.3): 'Acceptors' were significantly more likely to attach some value to policy makers' views of climate change compared to 'Uncertains' who ascribed little value and 'Sceptics' who attributed almost no value. 'Acceptors', although attributing little importance to the policy publication (Green Paper) as a useful information source, credited more importance to it than 'Uncertains' and 'Sceptics' who thought the publication was of almost no importance.

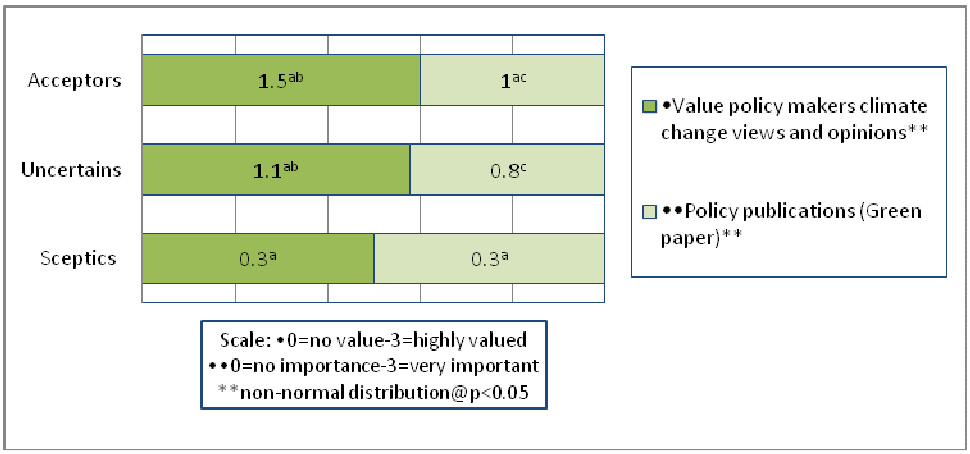

Figure 7.3 Cluster values concerning the Carbon Pollution Reduction Green Paper as an information source

'Acceptors' n=70-73; 'Uncertains' n=198-201; 'Sceptics' n=58-61
a = 99% confidence of statistically significant differences i.e. $p<0.01$
b = 95% confidence of statistically significant differences i.e. $p < 0.05$
c = no statistically significant differences

'Acceptors' responses in particular highlighted critical issues for government and climate change governance in rural WA. Although 'Acceptors' ascribed more value to policy views and information than the other typologies, they attributed a low value to both. At no point were there opposing responses expressed to any of the statements between the clusters. Additionally, there were associations of common

concerns displayed between the three clusters. These results point towards evidence of what Garvin (2001) describes as differences between what policy makers and the public think important. For example, policy makers viewed reducing Australia's emissions and incorporating agriculture into a Carbon Reduction Trading Scheme by 2015 as an important climate change mitigation policy strategy (Ford, Gurney, et al., 2009). However, Keogh (2011), suggests WA farmers and the agricultural industry have cause to be concerned about impacts of such policies on their businesses and communities,

The theme of differences, described by Garvin (2001) as important in analytical paradigms of risk/threat between policy makers and the public, was exhibited in this research in responses to the then incumbent Federal Government's drought assistance policy; Exceptional Circumstances (EC) Assistance.

7.4.2 Exceptional Circumstances Assistance: Issues of relevance of climate risk policy

At the time the research was being conducted, the Federal Government had commissioned a review of national drought policy. The review was to evaluate Exceptional Circumstances (EC) assistance and the future of government supported drought relief (DAFF, 2012). A detailed report of participant's responses to EC assistance is available in Appendix 12. To see what participants in the typologies thought of government's approach to climate risk this research looked at perceptions of EC assistance in regard to climate risk in rural WA.

Relevancy of EC criteria to WA farming conditions was questioned by participants in each cluster (Figure 7.4): 'Criteria for EC should be relevant to WA farming conditions and farmers/rural businesses needs'

- 56% of 'Acceptors' strongly agreed/agreed
- 60% of 'Uncertains' strongly agreed/agreed
- 69% of 'Sceptics' strongly agreed/agreed

'EC declaration process should be simplified';

- 55% of 'Acceptors' strongly agreed/agreed
- 55% of 'Uncertains' strongly agreed/agreed
- 67% of 'Sceptics' strongly agreed/agreed

'Drought assistance should be delivered on an individual basis without an EC declaration for a region';

- 43% of 'Acceptors' strongly agreed/agreed
- 42% of 'Uncertains' strongly agreed/agreed
- 71% of 'Sceptics' strongly agreed/agreed

'Farms and business should run down their equity in assets before being provided with EC assistance';

- 42% of 'Acceptors' strongly disagreed/disagreed
- 43% of 'Uncertains' strongly disagreed/disagreed
- 44% of 'Sceptics' strongly disagreed/disagreed

'More assistance is needed to exit the industry where necessary'

- 45% of 'Acceptors' strongly agreed/agreed
- 35% of 'Uncertains' strongly agreed/agreed
- 46% of 'Sceptics' strongly agreed/agreed

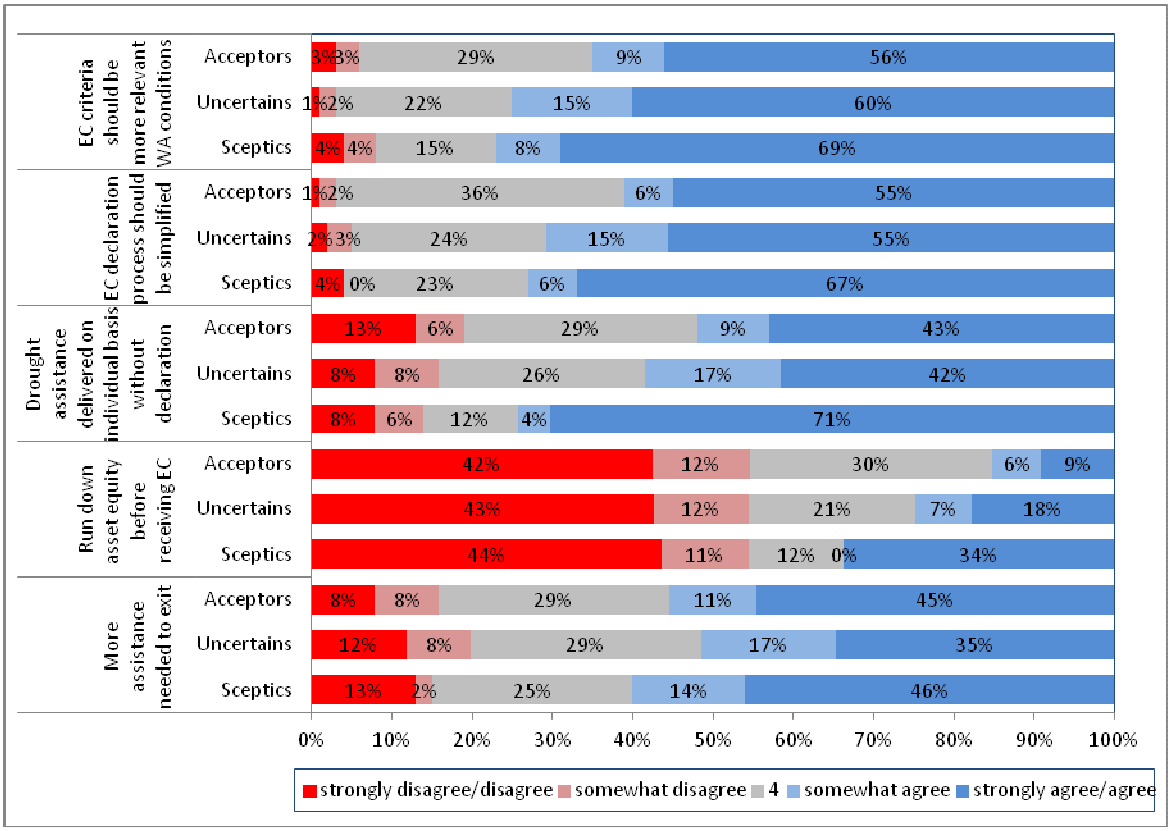

Figure 7.4 Perceptions of EC assistance
'Acceptors' n=65-66; 'Uncertains' n=180-183; 'Sceptics' n=52

The only statistically significant difference between the clusters was in response to: 'Drought assistance should be delivered on an individual basis without an EC declaration for a region' (Figure 7.5). 'Sceptics' supported the concept of drought assistance being delivered without a regional declaration (mean 5.7), while 'Uncertains' (mean 4.9) and 'Acceptors' (mean 4.8) were somewhat less supportive.

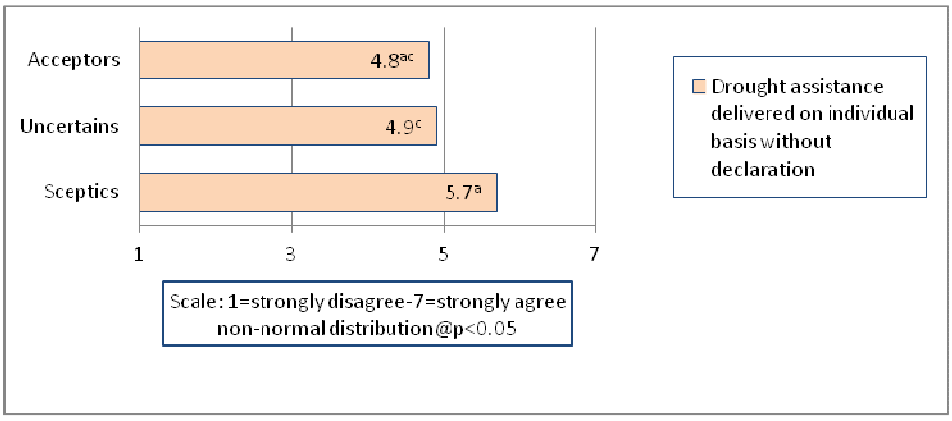

Figure 7.5 Perceptions of EC assistance

'Acceptors' n=65-66; 'Uncertains' n=180-183; 'Sceptics' n=52
a = 99% confidence of statistically significant differences i.e. $p<0.01$
c = no statistically significant differences

Again, responses to government climate risk policy indicated a high level of unanimity between the typologies even where there were some differences displayed with support for delivery of financial assistance on an individual basis.

7.5 Discussion

The attitudes of participants in all three clusters to government's role in climate change solutions and their perceptions of government's responses could be described as somewhat reserved, bordering on concerned. Most participants were not convinced future policy responses to climate change would be fair to farmers or rural communities or equitable to the industry. This may lead to a perception of unfairness an inequity which other research proposes (Adger et al., 2008; Bord et al., 1999; Lorenzoni and Langford, 2001) could challenge government's capacity to maintain trust and credibility with the rural public.

Likewise most participants in each cluster attribute credibility to government's development of potential climate change policy, policy makers' climate change views or government climate change publications. An example of the unanimity was the consensus among the typologies that politicians would use climate change as an election issue.

The results also pointed to what other research identified as distances and/or dichotomies of relevance and salience between analytical paradigms of government 'experts' calculated responses to climate change and drought, and participants perceptions of what is needed (Brody et al., 2008; Cash et al., 2002; Garvin, 2001). Basically, there were differences between what policy makers thought were important issues of risk/threat mitigation and what participants believed were relevant and salient.

As stated earlier in the Chapter, the less than favourable responses from 'Acceptors' to proposed government climate change policy initiatives to reduce Australia's

emissions and to include agricultures in a Carbon Trading Scheme by 2015 represent some challenges for policy makers in developing climate change policy. Unlike human-induced climate change acceptors in Maibach et al.'s (2009) American research who accepted that some policy initiatives would impact on them personally, 'Acceptors' in this research did not. Here was a typology who mostly accepted climate change was human-induced and a threat that needed to be responded to, but were not prepared to support policies which could have a detrimental effect on their livelihoods and industry. If government is not able to effectively 'sell' climate change adaption and mitigation policy to those who believe it is necessary, what chance does it have in trying to 'sell' policy to the uncertain or sceptical?

The results did not conclusively demonstrate that proposed government responses influenced participants' attitudes to climate change. However, the results did indicate that many participants were concerned about the impact future climate change policies may have on their businesses and way of life. Just prior to the surveys being conducted, Garnaut's (2008) 'Carbon Pollution Reduction Scheme Green Paper' was published and elements of this were extensively discussed in popular media. While very few participants had read the original published document or the summaries, there was a perception that farming and the agricultural industry could be disadvantaged under a Carbon Pollution Reduction Scheme (CPRS). This perception was not discouraged by results of a study undertaken by Keogh (2011) investigating the challenges which could confront Australian farmers under a CPRS. In addition, the lack of credence attributed to government information sources suggested Botterill and Mazur's (2004) conclusion that traditional risk communication methods of using 'experts' to communicate risk used by government and its agencies was approaching redundancy and a new approach to risk communication was needed.

Rural people have access to alternative forms of climate change information/knowledge sources. These sources include: social structures in the form of family, friends and neighbours, as well as the wider community, Landcare and industry groups. In addition, there is general and rural/agricultural media and the internet as well as agricultural industry and Landcare publications. These alternative information/knowledge networks and the importance or lack of importance

participants attribute these sources in providing climate change information is described in the next chapter (Chapter 8) – the final chapter of results.

Chapter 8: Information and Knowledge Sources

8.1 Outline

In exploring the knowledge and information sources that rural people thought were useful two approaches using multivariate analysis of information/knowledge values analysis were undertaken. The first approach described clusters of participants based on shared associations of information and knowledge sources. The second analysis analysed the information/knowledge sources valued by 'Acceptors', 'Uncertains' and 'Sceptics'. The results derived from the whole survey sample are described in Appendix 13. The other set of results of comparison analysis of 'Acceptors', 'Uncertains' and 'Sceptics' information/knowledge values are reported in Section 8.4.

It has been proposed that farmers did not accord science, government and/or extension officer's automatic legitimacy as they generated their own knowledge and applied a process of review and evaluation (Vanclay, 2004). The following section identifies the typologies based on information/knowledge sources to develop a more detailed understanding of rural Western Australians' climate change knowledge/information networks.

8.2 Grouping values of information/knowledge sources

The multivariate analysis (PATN 2.3; Belbin, 1993a) of participant responses to the information and knowledge sources they felt were valuable and important in accessing useful climate change information showed four clusters of values (Figure 8.6). The variable label relevant to cluster values and description of the statement and meaning is shown in Table 8.1. The clusters represent four statistically definitive associations of information values.

Cluster one: 'Personally controlled' information sources comprise six values associated with:

- TV news
- Current Affairs/documentaries
- Rural/Regional radio programs

- Agri-newspapers
- National/state newspapers
- Discussions with family and friends

Cluster two: 'Local context' information sources represent three values associated with farming and agriculture within the local environment:

- Industry/grower group publications
- Seminars/conferences/workshops/field-days
- Agricultural consultants

Cluster three: 'Non-local context' information sources include three values perceived as distant and removed from the local context:

- Internet
- Other publications
- Science publications

Cluster four: 'Non-local context-Policy' information source also represented a value perceived as distant and removed from the local context:

- Policy

Table 8.1 Cluster values – Labels for information sources

Variable	Variable label
TV News	TV
Current affairs/documentaries programs	AffairDoc
Regional/rural radio	Radio
National/state newspapers	NewsPaper
Agri-newspapers	AgPaper
Other publications ('Time' magazine)	OtherPub
Science publications	SciPub
Industry/grower group publications	IndPub
Seminars/conferences/workshops/field-days	Seminar
Informal discussions with family and friends	FamFriend
Agricultural consultants	AgConsult
Federal Governments Carbon Pollution Reduction Scheme Green Paper	GreenPaper

The statistical associations of values and participants were derived from Monte Carlo's Permutations with the r^2 derived from Principal Axis Correlations and the Kruskal Wallace value between groups (Table 8.2). The correlations of values are depicted in a Two-way table (Figure 8.6). (An ordination derived from the analysis of information and knowledge networks values and characteristics and accompanying description is available in Appendix 15).

Table 8.2 Statistically significant information cases & values ordination

Variable	Variable label	P derived from Monte Carlo's Permutations (MCAO)	r – squared derived from Principle Axis Correlation Pcc	Kruskal Wallis value between groups
Climate change is occurring	Accept	P < 0.001	0.051	31.95
Does not directly contribute to farming	Non-farmer	P < 0.001	0.068	17.13
Shire lived: Perth Metropolitan area	PerthMetro	P<0.001	0.032	6.13
Value scientists climate change views	Scientists	P<0.001	0.236	78.42
Value policy makers climate change views	Policy	P<0.001	0.169	53.72
Value Landcare groups climate change views	LandGrp	P<0.001	0.244	77.13
Value community groups climate change views	ComGrp	P<0.001	0.215	57.3
Value friends climate change views	Friends	P<0.001	0.228	78.1
Value neighbours climate change views	Neighbours	P<0.001	0.252	80.2
Value family climate change views	Family	P<0.001	0.196	63.13
Value industry/grower group climate change views	IndGrp	P<0.001	0.105	41.3

Member of a farmer / industry group	IndGrpYes	P<0.001	0.055	18.11
Member of Catchments or Landcare group	LCareYes	P<0.001	0.035	4.19
Climate change is part of a natural climatic cycle… not influenced by greenhouse emissions	Sceptics	P<0.001	0.06	27.17
Farmer	Farmer	P<0.001	0.068	17.13

The Two-way table derived from the multivariate analysis (PATN 2.3; Belbin, 1993a) illustrates statistically significant groupings of people and knowledge/information variables (Figure 8.1). The five colours displayed in the Two-way table (see the legend on the bottom left hand side of the table) depict strength of associations between the intrinsic knowledge/information variables displayed across the top of the table (which are described in the legend box on the top right hand side of the table) and participants displayed down the left hand side of the table. The degrees of correlation range from white which indicates no correlation, through to darker shades to black which indicate a high correlation.

The Two-way table shows nine clusters representing 93% of the survey sample with six of the larger clusters consisting of 84% of the participants. The clusters represent a spread of values ranging from groups of participants who attach some level of value to all sources of information through to those who value climate change information from only a few sources.

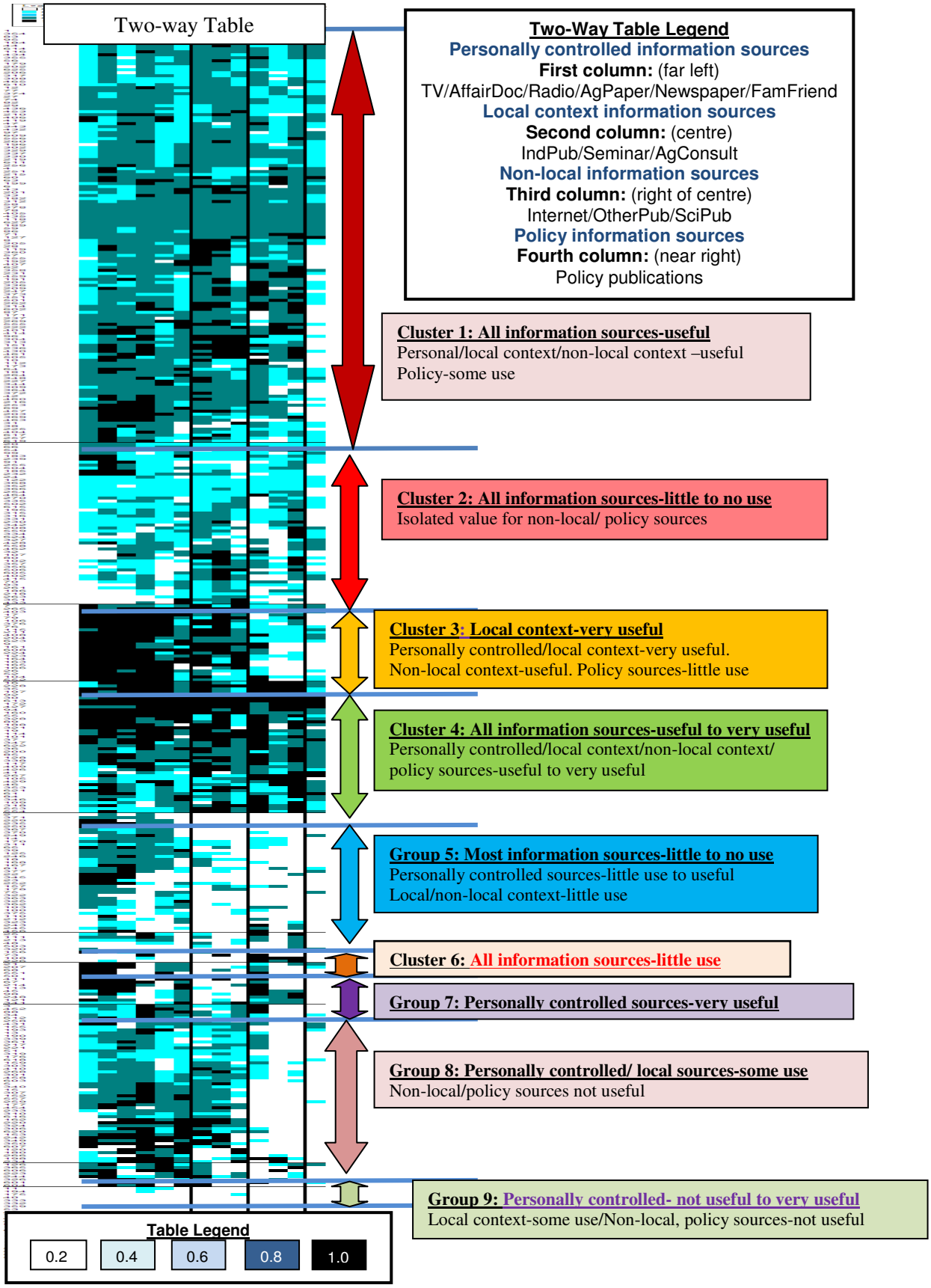

Figure 8.1 Information values clusters
n=382

Having identified the different clusters of participant information values, the research then examined demographical characteristics of participants in each cluster through responses to climate change, information and ease of understanding climate change information. This analysis was conducted to add to the profile characteristics and climate change values of each information cluster.

8.2.1 Information clusters' characteristics and climate change values

The demographic characteristics evaluated were farming or non-farming status of participants and if they were rural or urban residents in addition to membership of Industry/grower groups and Landcare groups. Climate change values examined included if climate change was occurring and if it was natural while the information values examined were participants' views on the importance of being informed about climate change and if they found the information easy to understand.

Cluster One*:* **'All information sources-useful'**

Cluster one comprised 34% of the survey sample. Participants in the cluster found personally controlled information sources, local context sources and non-local sources useful in sourcing climate change information (Figure 8.1). This cluster had a high proportion of urban residents (16%), which was more than the survey sample (11%) (Figure 8.7). Slightly less than half of the participants thought climate change was occurring and a quarter did not think it was natural. Although two thirds thought it important to be informed about climate change, only a third found the information easy to understand.

- Cluster characteristics:
  - 74% farm/business participants
  - 84% rural residents (16% urban residents)
  - 45% members of industry/grower groups
  - 33% members of Landcare groups

- Climate change values:
  - 44% agreed climate change was occurring

- 28% disagreed climate change was natural
- 66% felt it important to be informed about climate change
- 34% found the information easy to understand

Cluster Two: 'All information sources-little to some use**'**

Group two contained 14% of survey participants. Participants thought all information sources were of little to some use, but some did think non-local and policy sources were useful (Table 8.3). There was a relatively high representation of non-farmers (32%) in the cluster compared to the other clusters (Figure 8.7). Most participants in the cluster were sceptical about climate change and less concerned about remaining informed.

- Cluster characteristics:
  - 68% farm/business participants (32% non-farmers)
  - 93% rural residents
  - 56% members of industry/grower groups
  - 32% members of Landcare groups

- Climate change values:
  - 29% agreed climate change was occurring
  - 17% disagreed climate change was natural
  - 40% felt it important to be informed about climate change
  - 36% found the information easy to understand

Cluster Three: 'Local context-very useful'

Cluster three, with just six percent of the survey sample, was almost all farm/agribusiness participants who lived in rural areas (Figure 8.7). Participants generally favoured personally controlled, local context and non-local context information but thought little of policy sources (Table 8.3). Almost half of the cluster did not believe climate change was natural and nearly three quarters of the cluster thought it important to be informed about climate change.

- Cluster characteristics:
  - 92% farm/business participants
  - 96% rural residents
  - 40% members of industry/grower groups
  - 27% members of Landcare groups

- Climate change values:
  - 46% agreed climate change was occurring
  - 46% disagreed climate change was natural
  - 72% felt it important to be informed about climate change
  - 39% found the information easy to understand

Cluster Four: 'All information sources-useful to very useful'

Participants in this cluster were only one of two groups who attributed value to the internet as an information source (Figure 8.1). The cluster comprised 10% of the survey sample and thought personally controlled, local context, non-local and policy sources were either useful or very useful. There was a high proportion of non-farmers and urban residents in the cluster and it was also one of two clusters where over half of the participants (54%) found climate change information easy to understand (Figure 8.2).

- Cluster characteristics:
  - 68% farm/business participants; 32% non-farmers
  - 78% rural residents; 22% urban residents
  - 34% members of industry/grower groups
  - 32% members of Landcare groups

- Climate change values:
  - 36% agreed climate change was occurring
  - 40% disagreed climate change was natural
  - 69% felt it important to be informed about climate change
  - 54% found the information easy to understand

Cluster Five: 'Most information sources-little or no use'

Cluster five participants represented nine percent of the survey sample and found personally controlled sources somewhat useful but thought all other information sources were not very useful (Figure 8.1). A third of the cluster were non-farmers but almost all of the cluster lived in rural areas (Figure 8.2). This was another cluster whose participants displayed a high level of climate change scepticsm.

- Cluster characteristics:
  - 66% farm/business participants; 34% non-farmers
  - 97% rural residents
  - 32% members of industry/grower groups
  - 39% members of Landcare groups

- Climate change values:
  - 26% agreed climate change was occurring
  - 23% disagreed climate change was natural
  - 59% felt it important to be informed about climate change
  - 29% found the information easy to understand

Cluster Six: 'All information sources-little use'

Generally, participants in this cluster thought all information sources were of little use (Figure 8.1). The cluster was one of the smallest of the nine clusters comprising only two percent of participants in the survey and was the only cluster with more non-farmers than farmers (Figure 8.2). In addition, the cluster had the highest percentage of urban residents. No one in the cluster (0%) found climate change information easy to understand.

- Cluster characteristics:
  - 40% farm/business participants; 60% non-farmers
  - 67% rural residents; 33% urban residents
  - 30% members of industry/grower groups
  - 20% members of Landcare groups

- Climate change values:
  - 40% agreed climate change was occurring
  - 22% disagreed climate change was natural
  - 67% felt it important to be informed about climate change
  - 0% found the information easy to understand

Cluster Seven: 'Personally controlled information sources-very useful'

Participants in this cluster thought personally controlled sources were very useful and, along with cluster four participants, favoured the non-local source of the internet (Figure 8.1). Local context and policy sources were not regarded as useful. Cluster seven was another small cluster representing three percent of the survey sample, of who over half found climate change information easy to understand (Figure 8.2). Compared to the other clusters more participants in this cluster believed climate change was occurring, and did not agree it was natural.

- Cluster characteristics:
  - 57% farm/business participants; 43% non-farmers
  - 86% rural residents; 14% urban residents
  - 17% members of industry/grower groups
  - 8% members of Landcare groups

- Climate change values:
  - 64% agreed climate change was occurring
  - 67% disagreed climate change was natural
  - 71% felt it important to be informed about climate change
  - 54% found the information easy to understand

Cluster Eight: 'Personally controlled/local sources-some use'

Cluster eight represented 13% of the survey sample and comprised a high percentage of farm/agribusiness participants and rural residents who were highly sceptical of climate change (Figure 8.1). The participants favoured personally controlled

information sources and thought local context sources were of some use, but did not think non-local and policy sources were useful (Table 8.2).

- Cluster characteristics were:
  - 92% farm/business participants
  - 98% rural residents
  - 55% members of industry/grower groups
  - 31% members of Landcare groups

- Climate change values:
  - 27% agreed climate change was occurring
  - 15% disagreed climate change was natural
  - 66% felt it important to be informed about climate change
  - 27% found the information easy to understand

Cluster Nine: 'Personally controlled information sources not useful to very useful '

Cluster nine was the smallest of the clusters and represented just two percent of the sample. Individuals in the group displayed a range of views with personally controlled information nominated as useful and not useful (Figure 8.1). However, there was a little support for local context sources, while non-local and policy were not considered useful. This cluster was comprised entirely of farm/agribusiness participants who were all rural residents that were mostly sceptical of climate change (Figure 8.2). Three quarters (75%) belonged to industry/grower groups and over half (55%) to Landcare groups.

- Cluster characteristics:
  - 100% farm/business participants
  - 100% rural residents
  - 75% members of industry/grower groups
  - 55% members of Landcare groups

- Climate change values:
  - 13% agreed climate change was occurring

- 25% disagreed climate change was natural
- 100% felt it important to be informed about climate change
- 14% found the information easy to understand

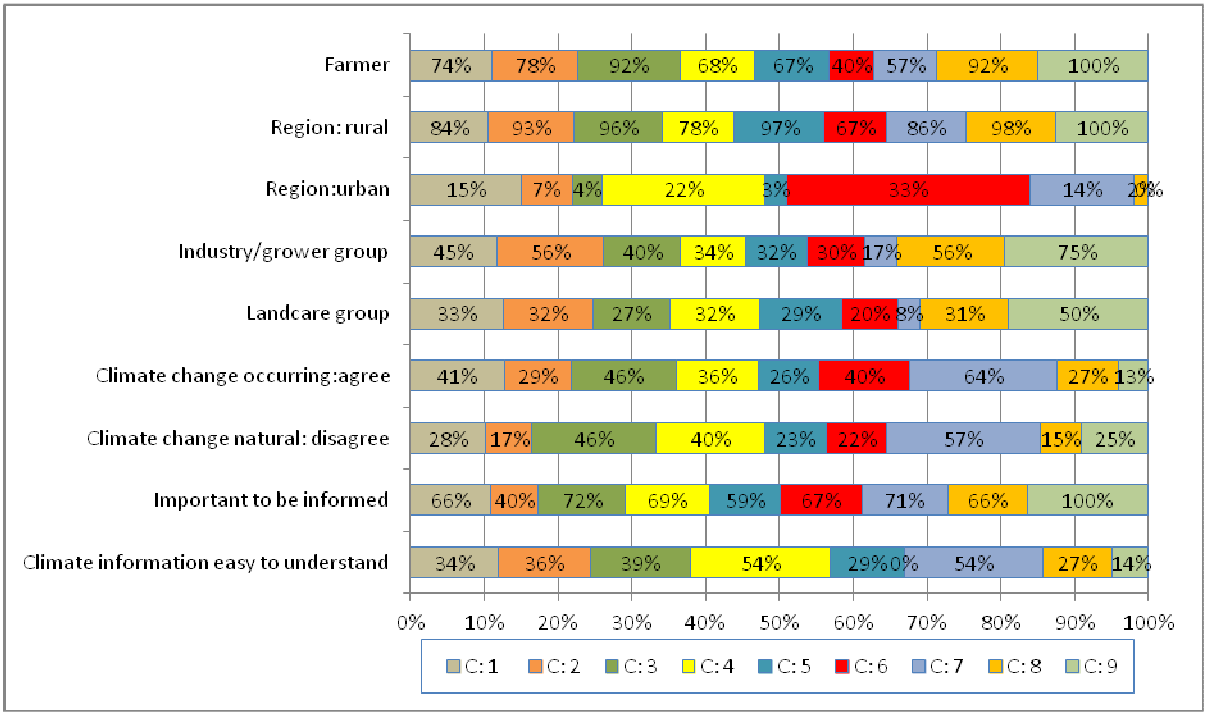

Figure 8.2 Information clusters demographic characteristics and climate change values
n=382

The results illustrated the multi-complexities of information networks that participants valued in accessing information. They also indicate the potential challenges science and policy face in diffusing climate change information/knowledge. For example, clusters with a higher percentage of farm/agribusiness participants and rural residents (Clusters: 3, 8 and 9) tended to all favour personally controlled information sources, although cluster three and eight also favoured local-context sources to varying extents (Figure 8.2). Despite the commonality in valuing personally controlled sources, clusters three and nine exhibited high levels of climate change scepticism and had fewer participants who found the information easy to understand compared to cluster eight. Cluster eight

had more participants who thought climate change was not natural and who found the information easy to understand.

Clusters four and seven, with higher percentages of non-farmers and lower percentages of farm/agribusiness participants, also had more participants who were inclined to accept climate change was not natural and found information about it easy to understand. Yet, the only individual information source of value in common to both clusters was the internet (Figure 8.1). Of the nine value clusters these were the only two clusters where a statistical value association of the internet was shown. The characteristics of these clusters suggest a reference point for future research. These clusters had the most participants (54%) who found climate change information easy to understand and participants tended to be younger and had lived in an area for less time than participants in the other seven clusters.

Added to the complexities confronting science and policy was the range between clusters in the ease of understanding information about climate change. At one end of the spectrum was cluster six which comprised the highest proportion of non-farmers. This cluster had 0% of participants who found climate change information easy to understand. On the other hand, clusters four and seven had 54% of participants who found the information easy to understand (Figure 8.2). However, 17% fewer cluster four participants believed that climate change was not natural (40%) than cluster seven participants (57%).

The results of the multivariate analysis (PATN, 2.3; Belbin, 1993a) demonstrated statistical associations that served to highlight the fractionalisation of information/knowledge sources/networks participants regarded as useful and important. In essence, from the results it could be hypothesised that participants' values of information sources were based more on socio-cultural constructs and less on their attitudes to climate change and capacity to understand the information. As Covello and Johnson (1987) observed, people were more likely to be receptive to information that did not conflict with their values, beliefs and knowledge. Although the research had asked what information sources participants valued, it had not asked what type of climate change information participants were sourcing. This is perhaps a topic for future research.

Examining responses of 'Acceptors', 'Uncertains' and 'Sceptics' to information/knowledge sources was undertaken to reduce the level of complexities exhibited in the results of information value clusters. As stated at the beginning of the chapter, there would be two sets of results reported in the chapter; one which would cover the information values and the other which would report on results of the rural climate change typologies' responses to information/knowledge sources. The results of this analysis are reported in the following section.

8.3 Clusters' information and knowledge factors

The three main typologies of 'Acceptors', 'Uncertains' and 'Sceptics' were derived from the multivariate analysis (PATN, 2.3; Belbin, 1993a) displayed distinct associations of values and characteristics within each typology. Therefore, it was important for the research to examine differences and associations as to which knowledge and information sources were considered to be valued and important.

The first step in the analytical approach of evaluating the typologies' responses to information/knowledge sources was to conduct a Factor analysis to explore interdependent relationships between sequences of responses to metric scaled questions. Because some of the questions used in the research had been developed as part an exploratory process, Factor analysis was used to examine if there were interdependent relationships between the climate information and knowledge questions. Responses to the questions regarding climate change information and knowledge sources were tested to determine if they answered some questions in a similar manner. If responses to separate questions were similar, the number of questions used in further research could be reduced.

Two Factor Analyses were undertaken because different values were applied to each set of questions. To begin with, a Factor analysis of the variables associated with the value of different social structures' opinions regarding climate change was carried out. A Kaiser, Meyer and Olkin measure of sampling adequacy of 0.80 indicated the Factor analysis of these variables was good (Chi- square 737.336, df 28, $P < 0.01$).

Principal component analysis extracted two factors with Eigen values greater than one which described 65% of the variance in responses. Both factors were shown to be reliable with Cronbach Alpha scores greater than 0.7 (Table 8.3).

Table 8.3 Principle components of valued climate change knowledge sources

Rotated Component Matrix[a]	Component/ factor	
	1	**2**
Factor 1: 'Local knowledge sources'		
Friends	0.90	
Neighbours	0.87	
Family	0.79	
Community groups	0.76	
Farm/industry groups Landcare/catchments groups	0.53	**0.51**
	0.53	**0.56**
Factor 2: 'Specialised knowledge sources'		
Climate change scientists		0.85
Policy makers		0.75
Landcare/catchments groups		0.56
farm/industry groups		0.53
Factor Mean	11.4	6.93
Eigenvalue	3.7	1.5
Percentage Variance (%)	45.9	19.3
Cumulative Variance (65%)		
Cronbach's Alpha	0.85	0.70

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 3 interactions

8.3.1 Reliability testing of climate change knowledge factors

Factor one: 'Local knowledge sources'

Factor one comprised elements related to knowledge sources which were accessible to participants in a local context. These included, friends, neighbours and family as well as community groups such as sporting clubs, School Parents and Citizens Associations (P&C) in addition to Landcare and farm/industry groups. A Cronbach's alpha of 0.85 indicated the factor to be highly reliable.

Factor two: 'Specialised knowledge sources'

Factor two represented knowledge sources which could be regarded as specialised such as climate change scientists and policy makers, along with Landcare and

industry groups. A Cronbach's Alpha of 0.70 indicated the factor was sufficiently reliable. In addition, it should be noted that 'Landcare' and 'Industry groups' cross-loaded with both factor one and two (Table 8.3).

A Factor analysis of the useful climate change information sources was then undertaken. A Kaiser, Meyer and Olkin measure of sampling adequacy of 0.80 was good, indicating the Factor analysis of these variables would also be constructive (Chi- square 1296.013, df 78, $P < 0.01$).

Principal component analysis extracted three factors with Eigen values greater than one, which described 58% of the variance in responses (slightly less than the required 60%). This could suggest other unknown or unidentified variables may also be contributing to responses. All three factors were sufficiently robust with Cronbach Alpha scores greater than 0.7 (Table 8.4).

Table 8.4 Principle components of climate change information sources

Rotated Component Matrix[a]	Component/Factor		
	1	**2**	**3**
TV news useful information source	0.83		
Current Affairs/documentary programs	0.80		
Radio (Country Regional)	0.67		
National/state newspapers	0.65		
Informal discussion with family & friends	0.46		
Industry/farmer grower groups' reports/articles		0.77	
Agricultural consultants		0.74	
Seminars, conferences, workshops & field days		0.74	
Agri-newspapers	**0.41**	0.67	
Science publications			0.84
Other publications (e.g. *Time* magazine)			0.80
Internet			0.65
Policy publications			0.58
Factor Mean	10.6	6.8	4.6
Eigenvalue	4.2	2.0	1.4
Percentage Variance (%)	31.9	15.5	10.9
Cumulative Variance (58%)			
Cronbach's Alpha	0.78	0.77	0.72

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 6 interactions

8.3.2 Reliability testing of climate change information sources factors

Factor one: 'Personally controlled information sources'

Factor one comprised six personally controlled elements of information access which included five popular media sources and one personal source of social exchanges with family and friends. A Cronbach's alpha of 0.78 indicated the factor was reliable.

Factor two: 'Local context information sources'

Factor two included the information sources of: agri-print media, publications and facilitated/consultative groups and personal interactive activities related to farming and the agriculture industry. These could be considered sources with a profound localised socio-cultural context. The factor was shown to be reliable with a Cronbach's alpha 0.77. Of note was the cross-loading of agri-newspapers with factor one: 'Personally controlled information sources as well as this factor.

Factor three: 'Non-local information sources'

Factor three consisted of information sources that could be deemed to be distant and removed from a local context and included science publications along with alternative socio-political publications (e.g. *Time* magazine), in addition to policy publications ('The Federal Government's Carbon Pollution Reduction Scheme Green Paper'; Garnaut, 2008) and the internet. A Cronbach's Alpha of 0.74 indicated this factor was also reliable.

The Factor analyses indicated that there were three separate socio-information elements participants found were similarly useful for climate change information. The research then compared responses to see if there were associations of information/knowledge sources between the climate change value clusters of 'Acceptors', 'Uncertains' and 'Sceptics'.

8.4 Rural climate change typologies of information/knowledge values

ANOVA and associated appropriate relevant tests were again used to compare responses and see if there were significances of difference between questions. Results indicated there were no significant differences between responses of participants in the clusters concerning values attributed to personally controlled information sources of: family; friends; neighbours; agri-newspapers and TV news. Neither was there significant differences in value ascribed to the local context sources of agricultural consultants and community groups (descriptions of these results are available in Appendix 14).

There were, however, significant differences between responses of participants in the clusters concerning the value and importance credited to climate change views and information sources of:

- Personally controlled information sources:
    - Current affairs/documentary programs
    - Regional/rural radio programs
    - National/state newspapers

'Acceptors' were more likely to assign a significantly higher importance to Current affairs/documentary programs in providing useful climate change information than 'Sceptics' (Figure 9.9). Additionally, rural/regional radio was viewed as equally important by 'Acceptors' and 'Uncertains', compared to 'Sceptics'. 'Acceptors' were more likely to feel national/state newspapers were also a useful information source than 'Uncertains' and 'Sceptics'.

There were also differences between responses of participants in the clusters concerning climate change views and information sources of:

- Local context information sources:
    - Industry/grower groups' views and publications
    - Landcare groups' views
    - Seminars/conferences/workshops/field-days

In terms of local context sources, 'Acceptors' and 'Uncertains' to a slightly lesser extent were inclined to more highly value the climate change views of Landcare groups compared to 'Sceptics' (Figure 8.3). Similarly, 'Acceptors' and 'Uncertains' credited a higher value to the climate change views of industry/grower groups than 'Sceptics'.

Field-days/seminars/conferences/workshops were largely considered important as climate change information sources by 'Acceptors' and 'Uncertains' compared to 'Sceptics' who tended to think these activities were important information sources (Figure 9.9). Likewise, both 'Acceptors' and 'Uncertains' (mean 1.8) thought grower industry/grower groups' publications were important climate change information sources, unlike 'Sceptics' who ascribed less importance to the publications.

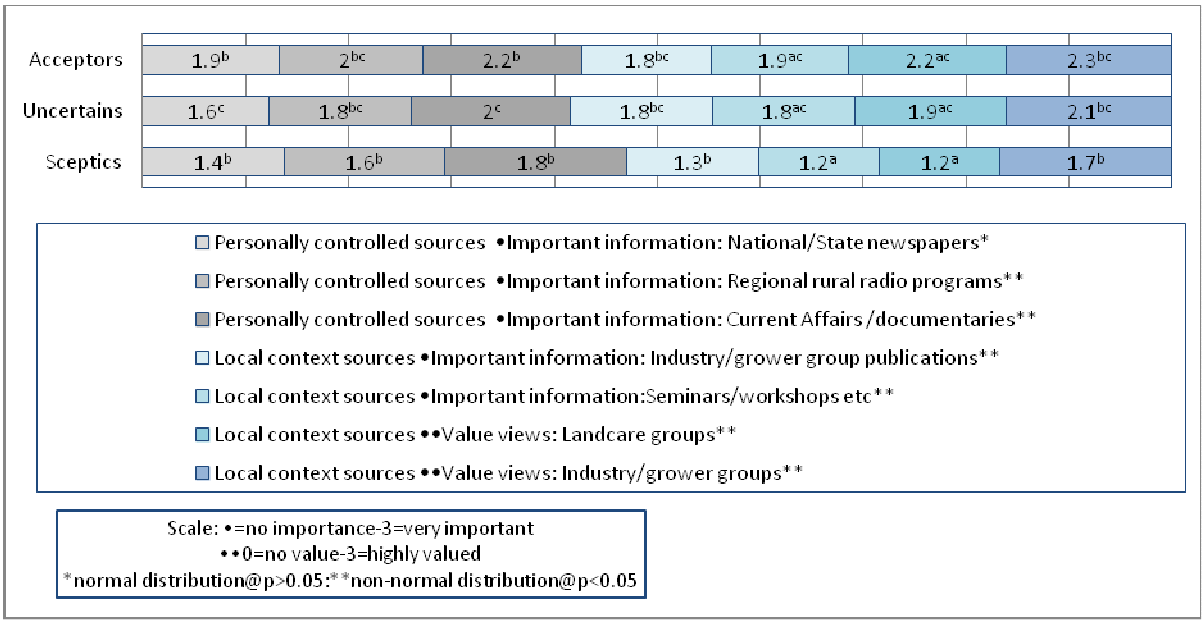

Figure 8.3 Clusters' values of distant expert sources of climate change views

'Acceptors' n=71-74: 'Uncertains' n=199-203: 'Sceptics' n=53-54
a=99% confidence of statistically significant differences i.e. $p<0.01$
b=95% confidence of statistically significant differences i.e. $p < 0.05$
c=no statistically significant differences

There were also marked differences between the three typologies in the value attributed to non-local context sources of climate change information (Figure 8.4).

- Non-local context information sources:
  - Climate change scientists' views and science publications

- Internet
- Other publications

'Acceptors more highly ' valued scientists' views than 'Uncertains', who never the less valued scientists views more than 'Sceptics', who place little value on scientists' climate change views. Science publications were also credited as important climate change information sources by 'Acceptors' whereas 'Uncertains' ascribed little importance and 'Sceptics' very little importance to the publications. Alternately, 'Acceptors' thought the internet was somewhat useful as an information source as did 'Uncertains' to a lesser extent but 'Sceptics' thought it was of little use. 'Other' publications were also attributed some importance by 'Acceptors' as an information source compared to 'Uncertains' who rated 'other' publications of little importance and 'Sceptics' who considered them of almost no importance.

As noted in the previous chapter (Chapter 8), all the clusters had a less than favourable view of policy sources of climate change information/knowledge (Figure 8.4).

- Non-local context-policy:
  - Policy makers' views and policy publications

Although 'Acceptors' did not place great value on policy makers' views on climate change they valued policy makers' views more than 'Uncertains' who ascribed little value and 'Sceptics' who thought policy makers' views were valueless (Figure 8.4).Likewise, 'Acceptors' (mean 1.0) and 'Uncertains' thought policy publications were of little importance as a source for climate change information they attributed more importance to the publications than 'Sceptics' attached almost no importance to the publications.

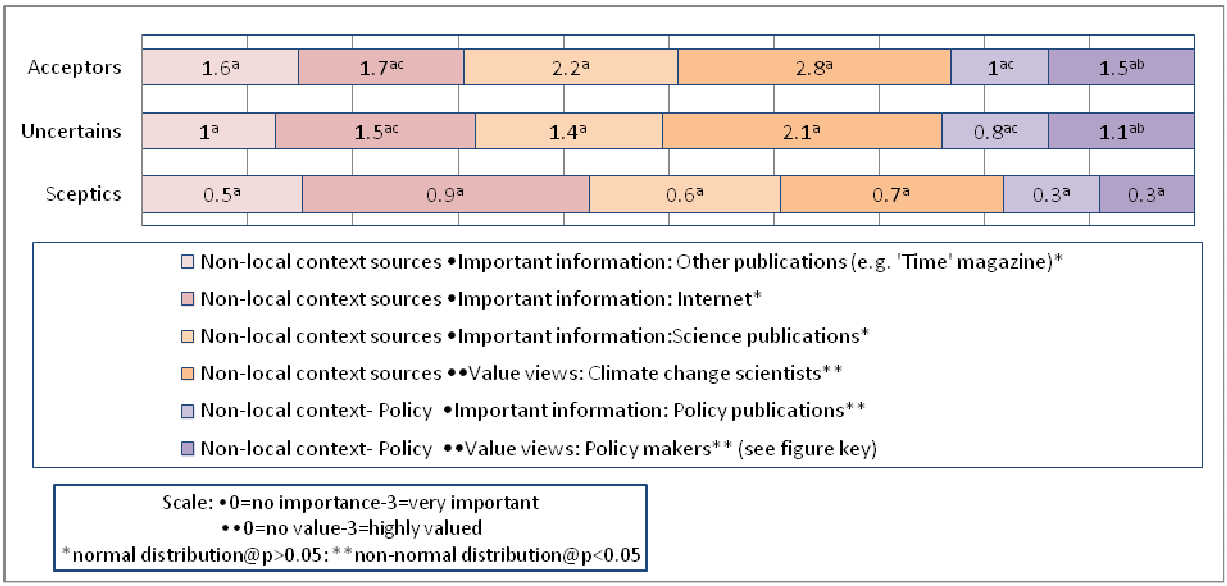

Figure 8.4 Clusters value of distant expert sources' climate change views

'Acceptors' n=71-74: 'Uncertains' n=199-203: 'Sceptics' n=53-54
a=99% confidence of statistically significant differences i.e. $p<0.01$
b=95% confidence of statistically significant differences i.e. $p < 0.05$
c=no statistically significant differences

In almost every instance 'Acceptors' nominated the individual sources within each of the four information/knowledge networks as more valued or important than 'Uncertains' and 'Sceptics'. With the exception of policy publications, 'Acceptors' consistently credited value and importance to the sources in the three fields of personally controlled, local and non-local contexts. 'Uncertains' also attributed value or importance to most information/knowledge sources, although in most cases at lower levels than 'Acceptors'. On the other hand, 'Sceptics' mainly only rated as valued or important the personally controlled sources of: family; friends; neighbours; agri-newspapers; rural radio programs and current affairs/documentary programs. However, 'Sceptics' also valued the local context source of industry/grower groups.

In evaluating the clusters' responses it could be posited each of the typologies were exhibiting layering traits of heuristic socio-cultural construction, sensitivity and familiarity of climate risk based on collective and individual experiences and perceptions as other research had indicated (Covello and Johnson, 1987; Gruev-Vintila and Rouquette, 2007) .

Again it was the extent of experience which appeared to be the underpinning influence. 'Acceptors' with less experience of living in area or involvement in farming were more open to accepting climate change knowledge/information from non-local and specialised sources than 'Sceptics'. conversely 'Sceptics' with a proportionately higher percentage of participants with extensive experience of living in area, farming and an extensive family history in farming tended to only value most local context sources and ascribed little value to science's sources. This may be an additional element which contributed to tensions between the knowledge forms of farmers and science, similar to that which had been shown in other studies (Cohen, 2009; Holloway, 1999).

Finally the value 'Acceptors' and 'Uncertains' attributed to the climate change views of Landcare groups may have reflected the typologies high level of environmental investment in their farms as well as the intrinsic pro-environmental values exhibited by both clusters in their homes and businesses (Chapter 6; Section 6.6). As was shown in the Familiarisation study (Chapter three) and earlier research, empathetic socio-cultural environmental connectedness is linked to climate change concerns (Barr 2007; Maibach et al., 2007).

8.5 Discussion

The multivariate analysis (PATN, 2.3; Belbin, 1993a) of information/knowledge characteristics illustrated a diverse and disparate range of responses spread across nine groups of participant information value clusters delineated by significant associations within each cluster (Table 9.3). However, the multivariate analysis (PATN, 2.3; Belbin, 1993a), along with the Factor analyses, identified four principal information source networks that were viewed as mostly valuable or important. An exception was the policy source in the non-local context networks that was not considered favourably by participants generally or by participants in each of the clusters, including the 'Acceptors'.

Essentially, most participants valued the climate change views of social structures closest to them in a socio-cultural and spatial sense, with the exception of scientists. Scientists who were categorised as a non-local source of climate change views were ranked equal second with industry/grower groups (mean 2.0) and just 0.1 behind

family (mean 2.1). The ranking of scientists alongside family and agricultural industry/farmer social structures as a valued view/opinion source points to the historically inclusive, if somewhat conflictive, relationship which has existed between science and farmers (Cohen, 2009; Vanclay, 2004; Holloway, 1999).

The primary differences between the information value clusters appeared to be derived from: participants' climate change values; where they lived; if they were farmers or not; and the value they placed on different information sources. However ease of understanding climate change information was not a determining factor in the information/knowledge sources valued by the various clusters. Each of the three clusters that had a high percentage of participants who did not find the information easy to understand placed different values on the various information/knowledge sources.

Alternately each the two clusters (clusters 4 and 7) with the most participants who found climate change information easy to understand valued different information/knowledge sources. For example Cluster four participants generally valued most non-local sources while cluster seven participants mainly valued the non-local source of the internet. However this demonstrates the importance of understanding the characteristics of various social structures in rural WA. The lack of value many cluster seven participants ascribed to local-context sources could be attributed to the higher percentage of non-farming rural residents in the cluster. These participants may have had little cause to be involved or interested in the other non-local source of science and local-context sources. It is worth noting that there were only two clusters which attributed value to the internet as an information source.

The information value clusters illustrated the multifaceted layering and complex networks of rural communities' information/knowledge systems. Although it was important to examine these structures, the complexity of the systems could preclude policy development of an effective information/knowledge transfer approach. Analysis of the rural climate change typologies reduced the complexities and identified which information/knowledge sources were valued by 'Acceptors', 'Uncertains' and 'Sceptics'.

As with the information clusters it appeared elements of socio-demographic characteristics were underpinning influences of clusters' attitudes to information/knowledge sources. The role of socio-cultural values and experience in constructing risk and influencing attitudes to information/knowledge sources described in other studies (Covello and Johnson, 1987; Gruev-Vintila and Rouquette, 2007; Holloway, 1999) also appeared to be influencing attitudes to climate change information in this research.

Fundamentally, 'Acceptors' with a higher proportion of participants with less experience in living in an area or farming valued most local context and non-local information sources with the exception of policy sources (Figure 8.5). 'Uncertains', with more experience of living in an area and farming also mainly valued all information sources with the exception of policy, but did exhibit some divergence in regards to science. Although 'Uncertains' were more likely to value the climate change views of scientists (mean 2.1), they were less inclined to view science publications as important information sources (mean 1.4). In turn, 'Sceptics' with proportionately more participants with the most experience of living in an area and farming really valued some personally controlled sources and viewed science and policy sources in particular as having little value or importance.

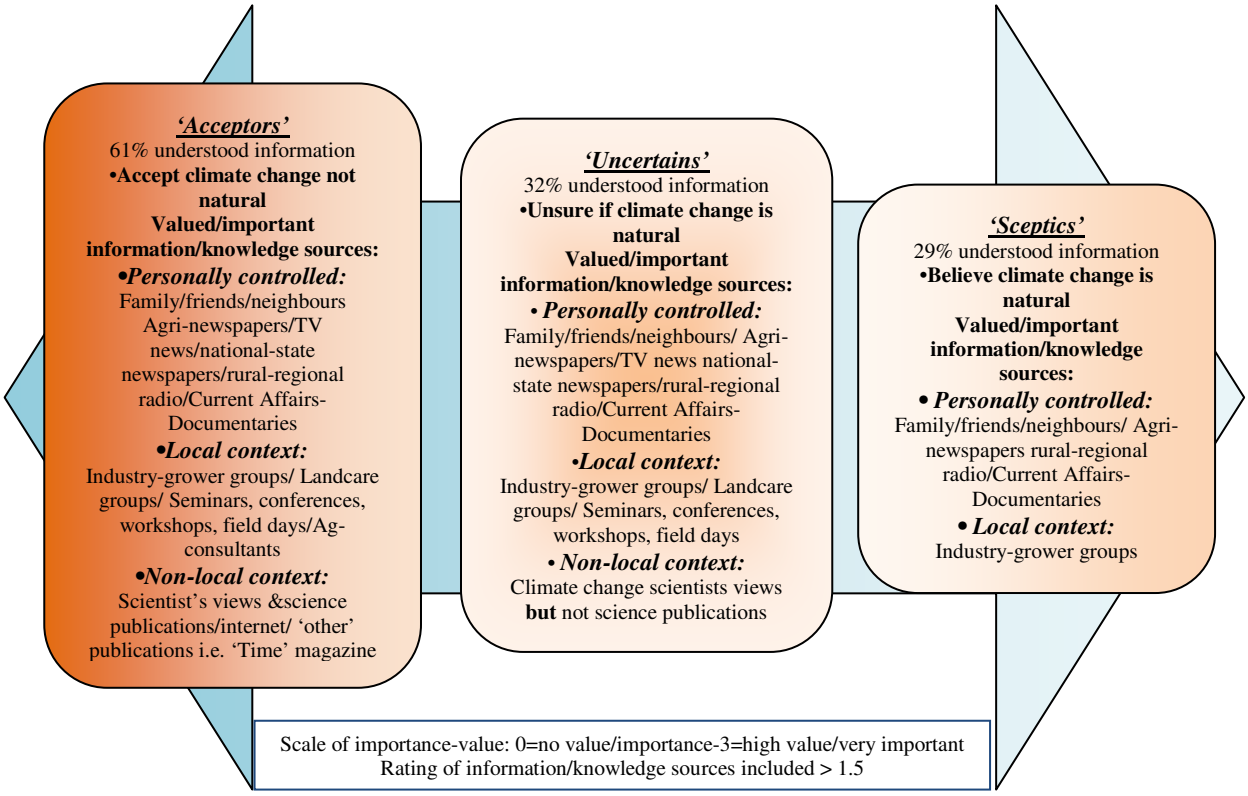

Figure 8.4 Summary of Rural Climate Change Typologies of information/knowledge values

These three general profiles and the nine profiles derived from the multivariate analysis (PATN 2.3; Belbin, 1993a) illustrated the inherent differences within and between information/knowledge networks of social structures in rural communities. In approaching the challenge of articulating climate risk information and knowledge it is important to understand rural peoples' relationships within social, economic, and biophysical contexts.

The low ranking of value that many participants in the 'Uncertains' and 'Sceptics' clusters attributed science's climate change knowledge sources may reflect the conflict and tensions Holloway (1999) and Vanclay (2004) described as existing between the knowledge forms of farmers and scientists. This indicates that the collaborative approach between science and the farming sector promoted by policy as contingent to developing future adaptive and resilience mechanisms within the rural sector may be confronted with some challenges.

Given that the 'Uncertains' and 'Sceptics' clusters comprised 65% of the survey sample, science and policy has a large section of the rural community that attributes little or no value to its climate change information and knowledge.

The question this research raises is whether there could be an issue, as Botterill and Mazur (2004) suggest, related to an increasingly ineffective model of risk communication to the public that governments' have traditionally relied on? Does government and science need to implement an alternative and more inclusive approach which is source sensitive to incumbent local knowledge forms to undertake such communication?

Conceptualisation and implementation of an alternative approach in the form of the Farm Business Resilience Pilot undertaken in WA as part of the Federal Governments Drought Pilot has indicated potential for more effective processes in communicating climate risk and adaptation/mitigation responses (Storer, Noonan, Heath and Murray-Prior, 2011). Early research has shown a group facilitated

iterative, action learning approach has led to significant changes in farmers' attitudes to climate change and climate risk management (Noonan et al., 2012; Storer et al., 2011). However, the issue of effective transfer of climate change knowledge and information between science, farmers and rural communities continues to remain an area for future research.

The need for research to continue and develop an effective strategy for communication of climate change risk and associated issues to rural people is discussed further in the following chapter along with concluding comments of the research results.

Chapter 9: Summary, Discussion and Conclusion

9.1 Chapter Outline

The objectives of the research were to examine rural Western Australians' attitudes to climate change, climate change science and some aspects of climate change governance. In addition, the research looked at factors which could be influencing rural Western Australians' attitudes to climate change such as information and knowledge transfer and perceptions of threat and risk to their businesses and lifestyles. This chapter summarises and discusses the results concerning participants' attitudes to climate change and climate change science. Linkages between environmental values and attitudes to climate change (Section 9.2) and government's role in climate change (Section 9.3) are also discussed. A summary of characteristics and values associated with 'Acceptors', 'Uncertains' and 'Sceptics' is presented in Section 9.4. Section 9.5 describes climate change information/ knowledge sources and networks valued or not valued by participants.

The recommendations discussed in Section 9.6 regarding the extension of climate change adaptation are offered as suggestions to better facilitate the diffusion of information, knowledge and adaptive/resiliency options within the Western Australian rural sector. The final sections in this chapter provide an assessment and discussion of the research limitations and suggestions for future research (Section 9.7), followed by the conclusion (Section 9.8).

9.2 Perceptions of climate change and climate change science

This research showed that a third (36%) of participants accepted climate change was occurring and 13% did not, while 51% were unsure or doubtful if it was occurring or not. In addition, 21% of participants thought climate change was natural and 24% did not, whereas 54% were uncertain or doubtful if it was natural or not. These responses were similar to rural participants' responses in Milne et al.'s (2008) MDB research.

However, more participants (43%) thought climate change was a threat to the future of rural communities than agreed climate change was occurring (36%), but 40% were uncertain or doubtful. In turn, fewer farm/agribusiness participants (33%)

believed climate change was a threat to the future of their farms/businesses, although 43% were uncertain or doubtful. Farm/agribusiness participants rated climate change as the least important priority to the economic sustainability of farms/businesses compared to fuel, fertiliser and chemical prices, interest rates, labour issues and environmental sustainability.

But was climate change a problem that needed to be engaged with? Although 52% of participants did not agree: 'There is no need to respond' to climate change, only 30% believed they were responding and 27% wanted to respond but were not sure how to.

The uncertainty exhibited by many participants to climate change occurring and its potential threat may have been related to their knowledge and experience of their local climates. Just 24% of participants believed rainfall had decreased a great deal over the previous 10 years and 26% had noticed a lot of increase in seasonal variability, while only 20% felt there had been more extreme weather events. In the previous 10 years, 82% of farm/agribusiness participants (N=308) had experienced poor seasons and 68% had experienced between two and four poor seasons in that period. As a result 72% had experienced decreased profitability, 52% increased debt and 63% increased stress, but 32% believed they had managed the poor seasons better than others around them.

Despite the farm/agribusiness participants' experiences and most participants noticing some level of increased seasonal variability (mean 4.5, scale:1=strongly disagree-7=strongly agree), as well as decreased rainfall (mean 4.4) and more extreme weather events (mean 3.9), most believed poor seasons and seasonal variability were part of living/farming in rural WA (mean 5.2). Only 26% of participants thought poor seasons and extreme weather events were linked to climate change (mean 4.1), while 40% believed there had been worse seasons and droughts than the ones that had just happened (mean 4.7).

But these experiences along with their general uncertainty about climate change and the potential threat did not mean participants were wholly dependent or favourably disposed towards science and scientific information. Over half (52%) believed science had not considered all the relevant factors in its estimations of climate change and 42% thought scientists would use climate change to access funding.

Additionally, only 32% thought that climate change information provided by scientists was useful and only 33% thought climate change information was easy to understand. But there was strong support for science to receive increases in government funding for agricultural climate change research (59%) and to work with agriculture and rural communities to find solutions for climate change (67%), while 69% of participants valued science's climate change views.

Although all of these variables represent credibility issues with science, it appeared that scientific divisiveness and the perceived funding agenda of science underpinned the credibility factor. As Langford (2002) had found, scientific debate about climate change was perceived as weakness by the public. However, participants viewed government's role in climate change and climate risk governance less favourably.

9.3 Perceptions of government's climate change policies: Issues of trust

Most farm/agribusiness and non-agribusiness participants did not think key criteria for drought relief executed under the auspices of Exceptional Circumstances (EC) assistance were relevant to Western Australian conditions. Over half (57%) of the farmers surveyed did not believe EC criteria for assistance was applicable to WA conditions and 54% thought the EC declaration process should be simplified. The other issue for 46% of farmers and businesses was the requirement for entire shires to be drought declared for individual farmers to be eligible for assistance (DAFF, 2012). The large land area of shires, particularly in the NAR, meant localised areas within undeclared shires could be drought affected but without an EC declaration for the shire affected farmers could not access assistance. During the survey a number of farmers cited examples where their landholding in an undeclared shire adjoined a declared shire but they were considered ineligible for drought assistance.

The farming participants' critical views of the EC declaration criteria reflected a more general perception that the socio-economic needs of rural Western Australians were a secondary consideration for policy makers. Few (9%) participants believed government climate change policy would be fair and sensitive to the needs of WA agriculture and rural communities. Many (46%) participants were doubtful or uncertain, while almost as many (43%) expected government to implement policies without taking the needs of the WA rural sector into consideration.

More (55%) participants were sure policy makers were not considering all relevant issues when developing climate change policies. But a critical major trust issue was the perceived lack of integrity of politicians, with 78% of participants certain that climate change would be used as an election issue to promote political agendas.

Credibility of policy makers was also questioned and policy publications were regarded as less than useful climate change information sources. Participants' lack of trust in government could be considered reciprocal, reflecting what Alston et al. (2004) described as a perception that government had distanced itself from the agriculture/rural sectors. Although this may not directly influence rural people's attitudes to climate change, it does suggest a perception amongst participants that agriculture and rural communities could bear an unequal share of the economic burden of climate change policies.

The analyses of: responses to climate change occurring; if it was natural; and climate change threat, although indicating consistent patterns of small percentages of certainty at either end of the scales and large percentages of uncertainty around the midpoint did not delineate what was influencing participants' responses. However, multivariate analysis (PATN, 2.3; Belbin 1993a) drew associations of characteristics and values together to describe three main value clusters representing 83% of the sample exhibiting climate change acceptance, uncertainty and scepticism.

9.4 Explaining the influences: Delineation of typological characteristics and values of 'Acceptors', 'Uncertains' and 'Sceptics'

There were three fundamental responses to climate change that delineated the attitudinal characteristics of each typology. The responses were: climate change was natural ('Sceptics'); climate change was not natural ('Acceptors') and uncertainty if climate change was natural or not ('Uncertains'). Each of these responses influenced the different perceptions of threat between each typology. 'Acceptors' believed climate change represented a major risk, while 'Sceptics' did not and 'Uncertains' were uncertain. In effect, as Finucane (2000) had found, participants' perceptions of climate change threat were based on their views of climate change being either a voluntary or involuntary type threat or uncertainty as to what type of threat it represented.

Underpinning participants' perceptions of threat type were the characteristics of experience and local knowledge derived from the extent of time they had lived in an area and/or time involved in farming and/or family history in farming. 'Acceptors' had lived in an area and been involved in farming and had less family history in farming for a significantly shorter period of time than 'Sceptics' and less time than 'Uncertains'. 'Uncertains' had also lived in an area for a significantly shorter period of time than 'Sceptics' and had also been involved in farming for less time than 'Sceptics'. This concurred with research that proposed that experience and familiarity with an activity decreased risk sensitivity and less familiarity with an activity increased risk sensitivity (Covello and Johnson, 1987).

In turn, the perception and level of sensitivity to climate change risk influenced the priority accorded climate change and responses to the risk. 'Acceptors' were more likely to be responding to climate change compared to 'Uncertains' while 'Sceptics' did not see the need. Similarly 'Acceptors' attributed climate change more importance on the future economic sustainability of the farm/business than 'Uncertains', whereas 'Sceptics' rated it of little importance. These responses indicated that only 'Acceptors' exhibited the 'awareness' of a problem that research had shown was integral in promoting motivation to take action (Linder, 1987; Pannell et al., 2006).

'Acceptors', in their less experienced evaluation. believed there had been more changes in the local climate than 'Uncertains' who had more experience and 'Sceptics' who with the most experience thought there had been only marginal changes. It could be proposed that 'Acceptors' within the limitations of their experience were more predisposed to think the changes in local climate were linked to climate change. Conversely, 'Sceptics' with more experience and familiarity with local climate believed the changes were part of a normal process and not linked to climate change .

An important difference between the 'Acceptors' and 'Sceptics' responses was shown in responses to the question: 'There have been worse seasons and droughts than the ones that had just happened'. 'Sceptics' were more likely (mean 5: on a scale of 1-7 where 1= strongly disagree and 7 = strongly agree) along with

'Uncertains' (mean 4.9) to agree. In comparison, 'Acceptors' were unsure if there had been worse seasons and droughts (mean 4.3)

This question illustrated the heuristic functions of availability, anchoring and adjustment described by Tversky and Kahneman (1972) used by 'Sceptics' and to a lesser extent 'Uncertains' which demonstrated why Sjoberg (2001) proposed that attitudes define risk. Because of their more extensive farming experience 'Sceptics' and 'Uncertains' were able to access more examples of previous events which they used as benchmarks to compare to the events that had just occurred. This in turn provided validity to particularly the 'Sceptics' knowledge and assessment of risk. As a result, 'Sceptics' knowledge challenged science's knowledge and assessment of risk.

The responses of the 'Sceptics' and 'Uncertains' demonstrate the potential other studies identified for tensions between local knowledge forms and science knowledge forms (Holloway, 1999; Vanclay, 2004). The less than favourable responses of 'Sceptics' and 'Uncertains' to the credibility of science and scientific information were more than likely an extension of those tensions and reiterate Holloway's (1999) observation that science needs to acknowledge the validity of farmers localised knowledge forms.

'Sceptics did not value scientist's climate change views or science's climate change information. 'Uncertains' also did not value science's climate change information, but were more inclined to value scientists' climate change views. It was only the 'Acceptors' with less experience of living in an area, involvement in farming and shorter family farming history than the other two typologies who valued both scientists views of climate change and scientific information.

The tensions between localised knowledge forms and forms of scientfic knowledge could also have contributed to the differing levels of understanding exhibited between the typologies in addition to comprehensibility of the information. Almost two thirds (61%) of 'Acceptors' found climate change information easy to understand compared with 32% of 'Uncertains' and 29% of 'Sceptics'.

However, when it came to government 'expert' information and knowledge, all three clusters exhibited a less favourable outlook. Although there were differences between the clusters regarding the value of policy makers' views on climate change, the differences were incremental unfavourable assessments.

What was of interest was 'Acceptors' responses of to some of the proposed climate mitigation policy initiatives. Acceptors' thought that government had not considered all relevant factors in forming climate change policies (mean 4.7: on a scale of 1-7 where 1=strongly disagree and 7=strongly agree) and also thought that reducing Australia's emissions without similar actions from the rest of the world would be useless in responding to climate change (mean 4.9). These responses were different to Maibach et al.'s (2009) American research that indicated people who were alarmed by climate change threat were more likely to support government policy responses.

These responses suggest that government may be faced with some challenges in promoting both domestic and national climate change policy to meet international emission reduction commitments. If government has difficulty in 'selling' policies to a group of people who believe adaptation and mitigation action is necessary, then it faces extraordinary challenges in trying to 'sell' the policies to those who are uncertain or sceptical.

Environmental values were another characteristic that delineated differences between the clusters. 'Acceptors' were more likely to have made higher environmental investments in their homes and businesses than 'Uncertains' and 'Sceptics'. The 'Acceptors' predisposition to pro-environmental behaviours concurred with research that proposed strong pro-environmental values were linked to the acceptance of human-induced climate change (Barr, 2007). The Aboriginal participants' responses in the Familiarisation study also supported this notion of a relationship between pro-environmental values and acceptance of climate change and the need to respond.

Of note was that there was almost no difference in long-term environmental investment made on farms between farmer 'Acceptors' (mean 5.5: on a scale of 1-7 where 1=strongly disagree and 7=strongly agree), 'Uncertains' (mean 5.3) and 'Sceptics' (mean 5.2) despite farmer/agribusiness 'Acceptors' rating the importance

of environmental sustainability to their farm/business sustainability significantly higher (mean 5.8) than 'Sceptics' (mean 4.7). It could be argued that these responses add further to Barr's (2007) views about the relationships between environmental values and attitudes to climate change. However, these results should only be considered as exploratory outcomes due to the limited selection of variables tested in the research. Any future research that attempts to examine peoples' environmental values within a socio-cultural framework should include the discourses of social structures entrenched within the environment as undertaken by Fleming and Vanclay (2009) and Wardell-Johnson (2007).

The differences in characteristics and values between 'Acceptors', 'Uncertains' and 'Sceptics', as summarised in the figure below, illustrate that the distinctions between each cluster show further questions remain (Figure 9.1).

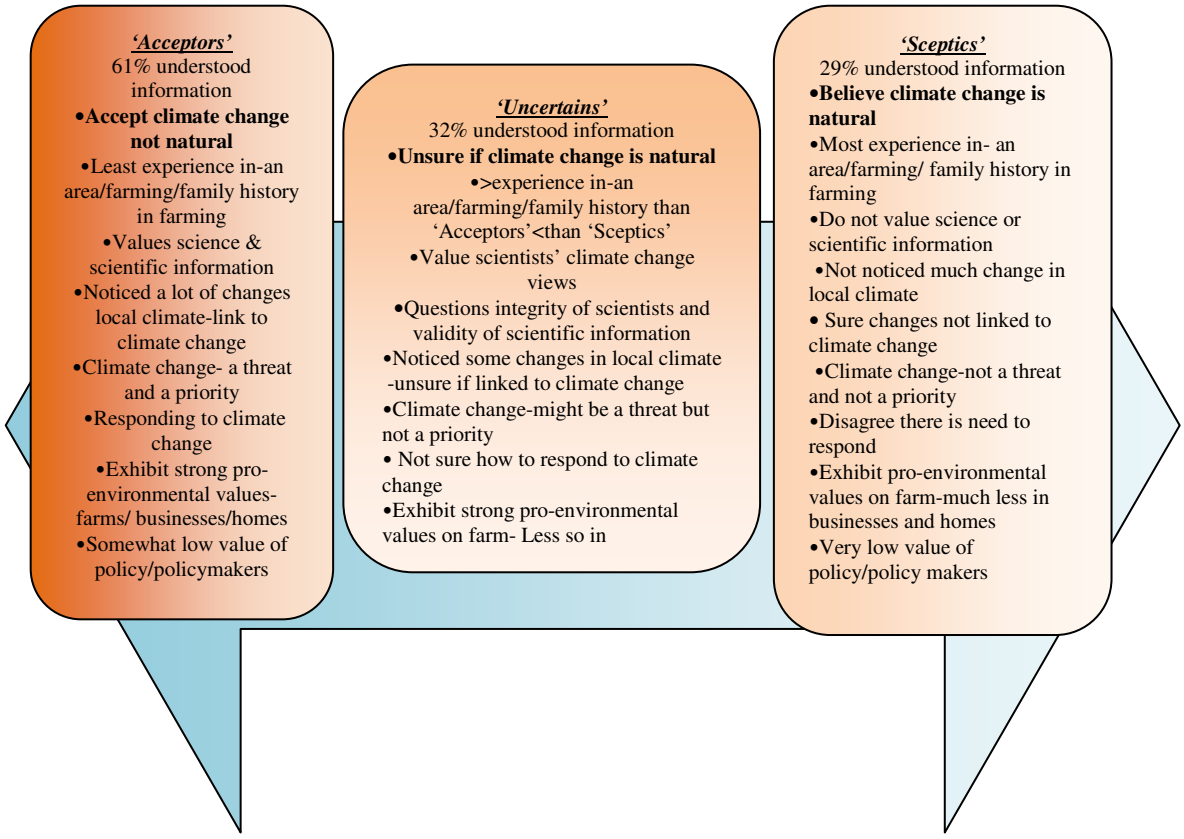

Figure 9.1 Differences in characteristics and values between 'Acceptors', 'Uncertains' and 'Sceptics'

Although the results point to a relationship between understanding the information, allocating credibility to science and attitudes to climate change, the structure of this relationship was not adequately explained. For instance, was the understanding of the information reliant on consistency with beliefs, values and experience as proposed by Covello and Johnson (1987) and how much did the consistency or lack of, with beliefs, values and experience contribute to trust and receptiveness of scientific information and knowledge ? Furthermore, was the integrity and credibility of science questioned because the complexity of the information and/or the problem as shown by Fleming and Vanclay (2009) seemed overwhelming?

Information/knowledge sources and networks were shown to be an integral component in participant understanding of climate change. The multivariate analysis (PATN, 2.3; Belbin, 1993a) of information/knowledge sources that participants thought were important or valued in providing climate change information illustrated the intergradations of sources and networks used.

9.5 Information and knowledge networks

Most participants chose to access climate change information through the intermediary medium of the media, which had already begun the translation process through visual and textural reporting (Smith and Joffe, 2009). Social structures such as family, friends, neighbours and community and Landcare groups were used to discuss and evaluate the information. This concurred with Holloway's (1999) notion that farmers assessed, translated and modified scientific information and knowledge to conform to their knowledge forms and local requirements.

Because the research was explorative, two approaches to the analysis of values associated with information/knowledge sources were taken. The first approach taken was a multivariate analysis (PATN, 2.3; Belbin, 1993a) of participants' values of information/knowledge sources. The second approach examined the values each climate change typology attributed to different information sources.

Although the multivariate analysis (PATN, 2.3; Belbin, 1993a) of information/knowledge sources depicted nine statistically significant clusters, the variations of values between the clusters in relation to climate change values and information/knowledge source values was, to a point, inconclusive and at times conflictive. The nine clusters comprised 93% of the survey sample with six larger clusters representing 84% of the survey sample. The range in the information sources valued and not valued by participants in each of the clusters was complex and extensive. Five clusters (clusters: one; three; four; seven; and eight) mainly valued personally controlled information sources such as print and electronic media, family and friends. In contrast, three other clusters (clusters: two; five; and six) attributed little value to personally controlled information sources as providers of climate change information (see Chapter 8; section 8.2. for a detailed description of the clusters).

Preferences for local context information sources including agricultural industry publications and agricultural consultations, seminars, conferences, workshops and field days was also diverse. Clusters one, three and four attributed value to local context sources, while clusters eight and nine attributed some value. However, local context information sources were assigned little value from clusters five, six and seven.

Values attributed to non-local information sources of the internet, other publications (*Time* magazine) and science publications also varied between the clusters. Clusters one and four ascribed value to non-local sources whereas clusters two and three attributed only little to some value. Clusters five, six, eight and nine placed very little value in non-local information sources, while Cluster seven was the only cluster that valued the internet as a valuable climate change information source.

The difficulty in using the clustering of information/knowledge values was further highlighted in comparisons of clusters four and seven which had the most (54%) participants who found climate change information easy to understand. A third (36%) of cluster four participants believed climate change was occurring and 40% believed it was not natural. In comparison, 64% of cluster seven participants believed climate change was occurring and 57% believed it was not natural. Although gender, age, extent of experience and farmer/non-farmer composition of

the clusters was similar, Cluster four generally valued all information sources including policy sources for climate change information. In contrast, most of Cluster seven highly valued personally controlled sources of television news, regional radio programs along with documentaries and current affairs programs and non-local internet sources, but attributed little value to newspapers, and all local context sources.

The key differences between the clusters, which may have contributed to the value ascribed to local context information sources, was that only 17% of cluster seven participants belong to an industry/grower group and 8% were members of Landcare groups. In comparison, 34% of cluster four belonged to industry/grower groups and 32% belonged to Landcare groups. Although membership of industry/grower and Landcare groups could explain differences between the two clusters concerning value assigned to local context information sources such as industry publications, seminars, workshops etc., and agricultural consultants, other differences remain which are more difficult to explain. For example; the low rating cluster seven ascribed other publications (*Time* magazine), science publications and policy publications compared to the higher rating cluster four attributed to these information sources.

The information value clusters represented a diverse and complex segmentation which could challenge the development of a cohesive and effective diffusion strategy. The analysis of the climate change typologies information/knowledge source values reduced the complexity and provided a more definitive picture of the differences between the typologies in the sources valued.

The results showed there were significant differences between 'Acceptors' and 'Sceptics' values of the personally controlled media information sources. 'Acceptors' placed more value on newspapers, regional radio news and talkback programs and current affairs/documentary programs compared to 'Sceptics'. Likewise 'Acceptors' attributed more value to local context information/knowledge sources of, seminars/workshops and industry/grower groups and Landcare groups than 'Sceptics'. Of note was that although 'Uncertains' tended to ascribe less value to the information/knowledge sources comprising personally controlled and local context sources than 'Uncertains', there were no significant differences between the

two typologies. However, 'Uncertains' placed significantly more value on rural/regional radio programs and industry/grower groups as information/knowledge sources than 'Sceptics'.

The differences in the value attributed to information/knowledge sources between 'Acceptors' and 'Sceptics' extended to the non-local context sources. Again 'Acceptors' ascribed more value to: other publications, scientists and science publications, the internet and policy publications than 'Sceptics'. There were also significant differences shown between the value 'Uncertains' attributed the non-local context sources compared to (in most cases) 'Acceptors' and 'Sceptics'.

'Uncertains' assigned a higher value to non-local context sources of other publications and science sources than 'Sceptics" but attached significantly less value to these sources compared to 'Acceptors'. However, 'Uncertains' shared similar values with 'Acceptors' to the non-local context sources of the internet and policy sources.

These results have contributed to the identification of potentially more strategic approaches to transferring climate change information/knowledge within WA farming and broader rural culture. However, future research is needed to develop a more comprehensive knowledge of the information/knowledge transfer processes and identify more effective communication pathways. .

9.6 Recommendations

The complexities of climate change with the uncertainty and doubt that are inherently embedded in the problem represent an extraordinarily difficult challenge for rural Western Australians. In building adaptive and resilience capacities in rural areas, climate change needs to be recognised and addressed as part of a number of interdependent components which could affect outcomes. Responding only to the potential threat of climate change in isolation would ignore social and other economic factors that could directly impinge on the capacity of proposed adaptive strategies to build resilience.

To address the challenges outlined, it is recommended that:

- More research is undertaken from a social perspective to better understand the social drivers of climate change risk assessment and the role these social drivers have in influencing changes in attitudes and behaviour.
- Research is conducted within each agricultural region examining influences of regional socio-cultural conceptualisation of climate threats and needs. The range and variance of climatic patterns, soil types and farming systems across rural WA suggest there could be social and biophysical characteristics of risk, vulnerability and relative advantage specific to each region (Nelson, Kokic, Elliston and King 2005).
- The language used by science and extension be reviewed with the objectives to:

1. Use language farmers are familiar with to improve understanding of information.
2. Advance up-scaling of farmers and rural landholders' climate knowledge.
3. Present context-relevant information to reduce conflict and tensions between rural people's local knowledge forms and science's knowledge forms.
4. Create a socially equitable platform between local rural social structures and the scientific community to facilitate direct cooperation via reciprocal communication of information and knowledge between the two groups.
5. That the expression "Climate change" be made redundant and not used in any extension language with farmers. Farmers generally perceive climate change as a broadview topic associated with global impacts, lacking saliency at a local level. An alternate expression, such as "seasonal variability" is familiar to farmers and describes localised climatic activity that farmers recognise. The Victorian DPI 'Practice Change' extension team used this approach in extension work with farmers in 2005 (Anderson, Victorian DPI, pers com 2009).

- Science instigates and documents a review of farmer's informal science processes and acknowledges the legitimacy of knowledge and outcomes derived from such processes.
- There should be increased government and industry funding support for face-to-face extension work. The Victorian DPI 'Practice change' extension team

have found interactive workshops to be effective in up-scaling farmers knowledge and diffusing practice change information at a local regional level (Souness, 2009), as did the WA Farm Business Resilience Pilot (Noonan et al., 2012).

- The following recommendations be considered in regard to policy:

1. The principle of depoliticising climate change in the public domain is explored.
2. Policy adoption of a needs-based approach (Panel on Strategies and Methods for Climate-Related Decision Support, 2009).
3. Adoption of a strategic risk management approach to seasonal variability instead of climate change. Adaptation to seasonal variability will (in the short to medium term) assist in addressing most needs associated with climate change (Beard, 2009).

9.7 Limitations of the research

Although the research identified a range of attitudes and a number of factors which broadly contributed to peoples' attitudes, there remains further questions as to the extent of influence each factor has on rural Western Australians' attitudes to climate change.

Arguably the research was also limited by the unequal representation of participants from certain agricultural regions. The influence of this on the results may not be determined until further research with more representation of people from the southern coastal and south west coastal regions has been conducted.

Other limitations in the research were associated with the use of different scales, definitions of labels and scaling labels, intangible differences between specific scaling labels and choosing to attach a nominal scale to the question: 'Is climate change information easy to understand?' The use of different scales and scaling labels and label definitions restricted the opportunity to conduct a Factor analysis of all variables simultaneously. As a result, the examination of interdependence between variables was limited to variable groups with the same scale or scaling label using the SPSS 18 analytical software. However, the availability of numerical taxonomy PATN analytical software (PATN, 2.3; Belbin, 1993a) did to a large

extent overcome these limitations. It would be advisable for future research to apply a consistent value on a seven point scale to questions relevant to the research.

Intangible differences in farmers' perceptions between the scale labels of 'Quite a bit' and 'A lot' is an example of the influence language could have on peoples' responses. Coming from a farming background I should have realised farmers have a tendency in public to use understated language to describe their actions, concerns or a situation. In my experience, the expression 'quite a bit' when used in a public setting by a farmer generally translates to mean 'a lot'.

This perceived intangibility was confirmed during the survey process. It was quite common for farmers to describe tree planting programs comprising hundreds of thousands of trees a year as 'quite a bit' of an investment in long term environmental responses. On other occasions, farmer participants would nominate an extensive acreage of land reclaimed from salt and revegetated or planted to trees and ask the interviewer to decide if it amounted to 'quite a bit' or 'a lot'. It did appear that farmers' perceptions of their levels of investment were derived from what they aspired or planned to do compared to what had been achieved.

The final limitations to be discussed concern the choice of scales used for the question 'Is climate change information easy to understand?' and the age demographic. In the case of 'Is climate change information easy to understand?' an opportunity to gauge the degree of understanding was missed by not using the seven point scale ranging from 'strongly disagree' to 'strongly agree'. Follow-up questions designed to capture the reasons for responses were also needed to expand on participants' issues and perceptions associated with the information.

Equally the five point scale and age range in each of the demographic categories was not at all relevant to the social context of the research and as a result, analysis of generational attitudes was largely inconclusive. The inclusion of the experience variables of time people had lived in area or been involved in farming did provide some degree of compensation but time spent living in an area or farming did not necessarily equate to age. It would have been more advantageous to have used the same scale for age as time lived in area, time involved in farming and family involvement in farming. This would have allowed for more relevant comparisons of

participants' perceptions and attitudes to be undertaken between age and experience demographics.

The limitations that have been identified in the research present ongoing opportunities for future research and to improve future approaches of future research. There remain essential questions concerning the social conceptualisation of climate change threat in different climate zones, farming systems and regions where farmers have access to alternative, non-agricultural dependent industries, i.e. the mining and resource industry. Another area that future research should continue is the examination of rural peoples' environmental values from the perspectives of how environmental values influence the decision to adapt and what type of adaptation is considered acceptable. Information derived from such research could be applied to the methods and approaches used to transfer information and knowledge and the development of adaptive innovations and enterprises within the agriculture and rural sectors.

Other research opportunities that emerged from the limitations of the study relate to the barriers concerning farmers and the broad non-farming rural populations' understanding of climate change information. This research identified issues with the comprehensibility of climate change information; it needs to be further examined to more clearly define specific areas which may enhance the improvement of communication and information transfer between science and rural people.

Finally, it is important that future research ensures that ages are scaled in a range that represents a relevant delineation of demographics. With a median age of fifty four for WA farmers and a projection that the median age will continue to rise (ABS, 2006), age could become an important factor in farmers' decisions to remain farming and adapt to climate change or exit the industry. There is also the prospect that the aggregation of WA farmers' knowledge and experience, which is integral to their decision making and planning, could become redundant in the face of increased climate instability. As Kingwell (2006) noted, increasing stochastic climate events may increase potential medium/long term vulnerability of farm businesses and systems if farmers continue to place heavy reliance on heuristic judgements drawn from experience and knowledge gained during an earlier period of more climatic stability.

9.8 Conclusion

The primary objective of this research was met in identifying the attitudes of rural Western Australians to climate change. The research identified the low levels of climate change acceptance and the high degree of doubt and uncertainty present among rural people at the time of the study. The research also showed that rural Western Australians were generally uncertain or doubtful about what was causing the climate to change more rapidly. Furthermore, the research found the high levels of uncertainty and/or doubt in climate change occurring and whether it was natural was also reflected in participants' perceptions of climate change threat to their businesses and communities.

In addition, the research identified that rural peoples' attitudes to climate change were influenced by their perceptions of science's credibility based in a large part on their own knowledge and experience, which in turn influenced their attitudes to climate scientists and scientific climate change information. During the process, the comprehensibility of climate change information and the value people credited scientific information with were identified as main points of influence. Key to the socio-cultural conceptualisation of climate change and climate change threat was the influence of farming and local experience. In effect, the extent of experience of living in area or involvement in farming and family history in farming correlated with attitudes to climate change, attitudes to climate change science and climate change governance.

The research suggests there is one fundamental element limiting the effectiveness of science and government agencies in communicating climate change risk to WA farmers. This element is the widespread aggregation of local climate experience and knowledge present within WA farming communities. In essence, farmers know what is known locally and in a broader domain, scientists know what is known across larger regions. While at present this simply represents a conflict between science and farmers' knowledge forms, increasing climate instability will raise a critical future challenge for science, government and WA farming communities as current knowledge is made redundant by emerging climate volatility.

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Appendices

Appendix 1: International research of public attitudes to climate change and perceptions of climate change threat

Early research suggested that a lack of conclusive evidence of climate change had reduced public acceptance of climate change to an act of faith (Van Dommelen, 1999). However, American research indicated that the public's views of climate change was characterised by uncertainty and indecisiveness (Bord, Fisher and O'Connor, 1999). In addition, UK studies found that attitudes were also characterised by doubt and disinterest (Lorenzoni and Langford, 2001), as well as denial and engagement (Langford, 2002). Langford's 2002 research identified six fundamental climate change attitudinal characteristics of: 1) uncertainty; 2) indecisiveness; 3) doubt; 4) disinterest; 5) denial; and 6) engagement.

Langford (2002) proposed that "denial" determined there was no threat and therefore no need to respond, whereas "disinterest" arose from a perception of no immediate personal threat. Langford (2002) asserted that "doubt" was derived from the perception that "experts" (science/government agencies) had been wrong in the past concerning impacts of environmental problems and were likely to be wrong again.

On the other hand, Langford (2002) and Bord et al. (1999) proposed "uncertainty" was an element of engagement. In Langford's (2002) estimation, engagement comprised two distinct characteristics of being either willing or keen. The distinction being those who were willing wanted to respond to climate change but were not sure how to, while those who were keen were certain response was needed and were taking action.

American and European studies during the 1990's and early 2000's indicated varying levels of climate change concern across populations in different regions (Lorenzoni and Pidgeon, 2006). A series of Gallup polls in America between 1989 and 2003 indicated 24%–40% of respondents were worried by climate change 'a great deal' and a Sustainable Energy Coalition survey (1996) showed 34% of respondents believed global climate change was a 'very serious' issue. Likewise Bord, Fisher and O'Connor (1998) found 43% of Americans thought it was 'somewhat important' to slow the rate of global warming.

Similarly in a UK study 62% of respondents climate change was either 'fairly bad' or a 'very bad thing' (OST/MORI, 2004). In turn a European study Research also showed that southern Europeans were more concerned about climate change due to increased perceptions of linkages between environmental degradation and decreased quality of life compared to northern Europeans who perceived less environmental degradation (European Opinion Research Group, (EORG) 2002) (Figure 1.1).

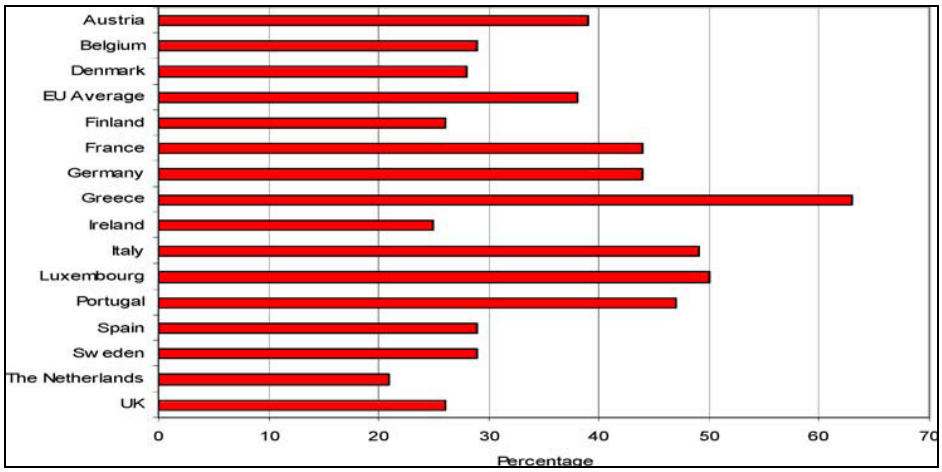

Figure 1.1 EU Member States percentage of respondents 'very worried about climate change'

(European Opinion Research Group, (EORG) 2002).

Research has demonstrated public awareness and concern about climate change was not one and the same. Climate change, although considered to be an important concern, was rated less important than terrorism or domestic, social economic and environmental issues (Norton and Leaman, 2004; Poortinga and Pidgeon, 2003a).

Poortinga and Pidgeon (2003a) research showed that while 62% of respondents were 'fairly' to 'very concerned' about climate change, their main concerns were health, safety, family and finances. Similarly, in an American survey (n=1060 adults), crime, education and health care were ranked in importance well above the environment. The 'greenhouse effect' was ranked 12th out of 13 other environmental concerns (Dunlap and Saad, 2001) (Figure 1.2).

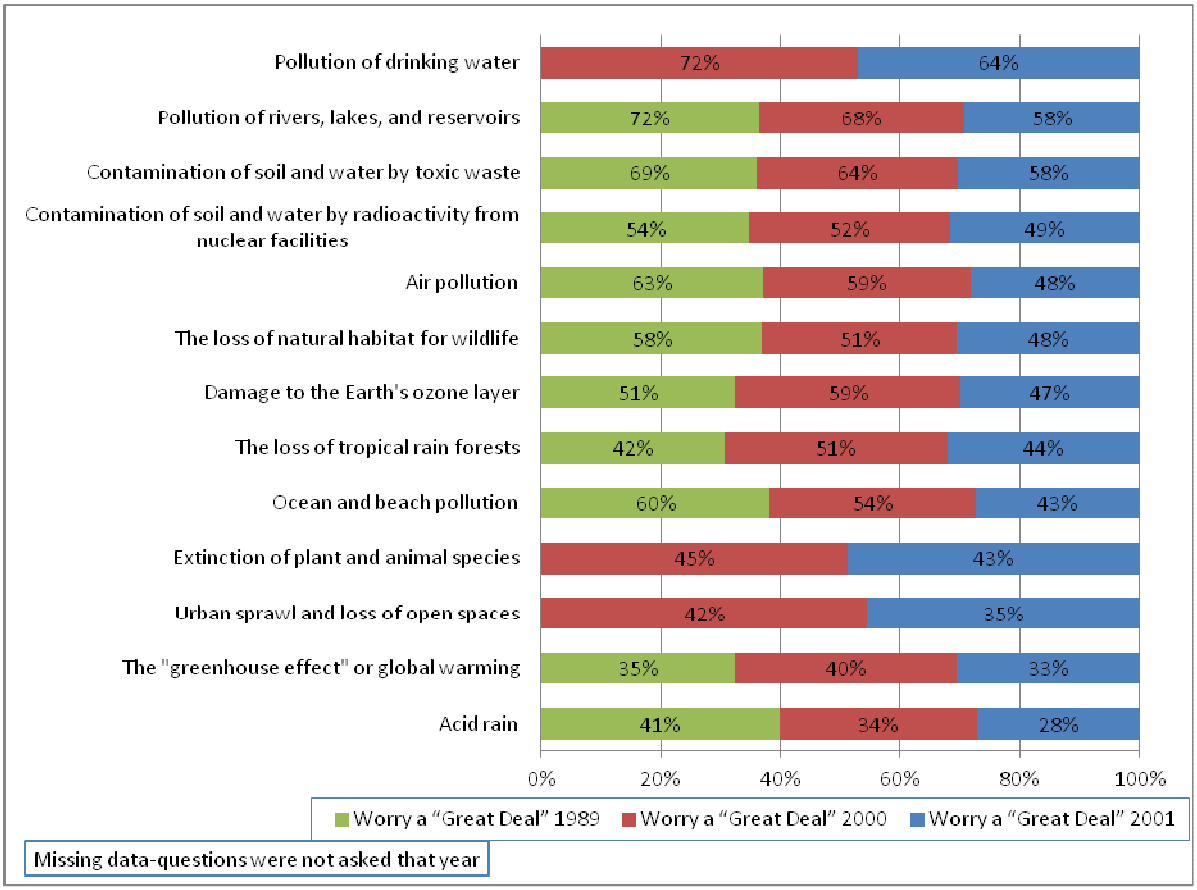

Figure 1.2 US Citizens' Environmental Worries

(Dunlap and Saad, 2001)

Research also identified a lack of understanding or uncertainty about climate change and its causes, which may have resulted in people rating climate change as a low priority (Berk and Schulman, 1995; Bord et al., 1998; Kempton, 1993; Leiserowitz, 2006). Research showed that despite high of awareness of climate change, people exhibited limited and at times erroneous knowledge of the topic Bord et al. (1998) (Figure 1.3).

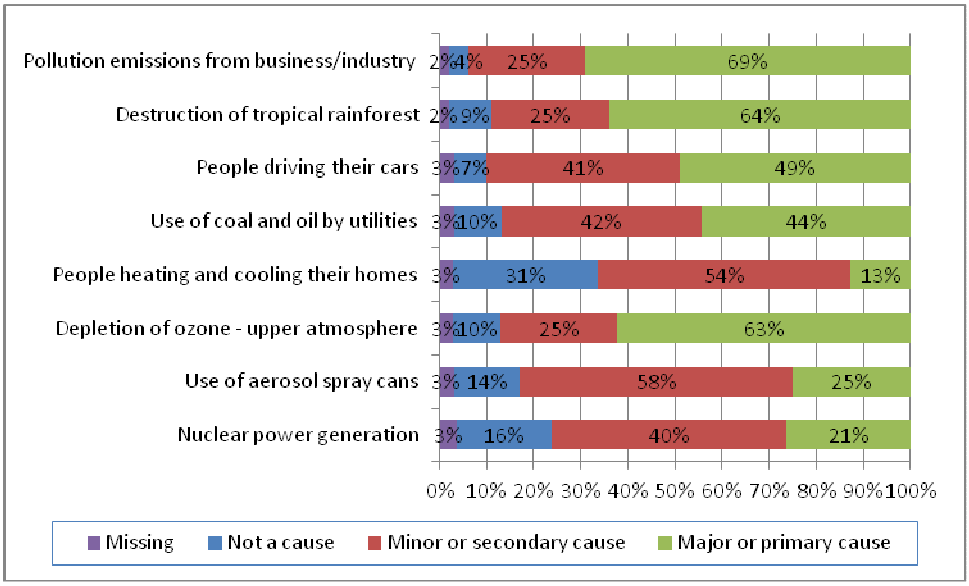

Figure 1.3 Judgements about causes of global climate change
(Bord et al., 1998)

Issues of misunderstanding and inconsistencies in concerns about climate change were also shown EU research. One study indicated 26% of respondents felt they lacked specific information about climate change (EORG, 2002). The research also found that although southern Europeans were more concerned about climate change than northern Europeans, they had only a tenuous grasp on the relationship between environmental degradation and a decreased quality of life.

Uncertainty and a lack of understanding and specific information about the causes of climate change indicate potential issues in the transfer of information and knowledge. Additional scientific information substantiating earlier evidence of climate change (IPCC Third Assessment Report, 2001; IPCC Fourth Assessment Report, 2007) appeared to have little effect on the public's understanding of climate change. Later research showed that uncertainty, flawed/inconsistent knowledge and low threat prioritisation continued to feature prominently in people's attitudes (Anable, Kelay and Lane, 2006).

An evidence-based review of the UK public's attitudes to climate change and transport behaviour concluded that there was only a tenuous connection between public awareness and knowledge of climate change and travel behaviors Anable et al.'s (2006). The review proposed that increasing public awareness to promote support of carbon reduction policies was important but awareness alone was not

enough to change behaviours and that enforced changes in behaviour could indirectly change attitudes.

Anable et al. (2006) proposed the adoption of a different approach in changing attitudes/behaviours. This was by engaging the public and incorporating an iterative element into the process thereby moving away from the 'top down' methods of providing information. To facilitate this approach it was recommended social profiling of peoples' values and beliefs associated with public transport and use of cars be undertaken. It was thought this would develop a better understanding of attitudes and behaviours in relation to public transport in how it was used. In essence, Anable et al. (2006) were suggesting the development of public transport use climate change typologies.

Appendix 2: Social profiling of Americans attitudes to climate change

An American study developed social profiling of the public's climate change attitudinal characteristics (Maibach, Roser-Renouf and Leiserowitz, 2009). In developing the social profiles the research explored what factors influenced participants attitudes. These factors included:

- Socio-demographic characteristics of: age, gender and education
- Beliefs
- Risk perceptions
- Response attitudes
- Priority issues
- Achievability of emissions reduction
- Political and consumer activism
- Policy preferences
- Information requirements
- Perceptions of climate change messengers (science, policy, media and local/personal information networks)

Responses to what was causing global warming showed 57% of respondents believed it was human activity and 33% thought it was natural. Five percent thought it was caused by both human activity and natural processes and three percent maintained it was not happening.

The, results showed 18% of respondents were 'alarmed' and 33% 'concerned' about climate change, while 19% were 'cautious' about climate change. The aggregation of these figures (70%) into a category of varying levels of concern were similar to earlier American research in which 34% of respondents thought climate change was 'very serious' and 37% felt it was 'somewhat serious' (Sustainable Energy Commission, 1996). this suggested there had been little change in Americans' levels of concern about climate change over ten years.

Maibach et al.'s (2009) research identified six different responses to climate change being: 'The Alarmed'; 'The Concerned'; 'The Cautious'; 'The Disengaged'; 'The Doubtful' and 'The Dismissive'. In addition, this research identified sets of socio-demographic characteristics and values associated with each of the six different responses.

'The Alarmed' were most likely to be females, older/middle aged (55-64 years old), with a college education and in an upper income bracket. They tended to support the Democrat Party, be community conscious with strong values of social equity and justice, which extended to supporting government intervention to ensure basic needs of all citizens. They believed protection of the natural environment was more important than economic growth and were less likely to be Evangelical Christians.

'The Concerned' were described as highly representative of the range of gender, age, income, education and ethnicities of American society. They tended to be average engagers in community activities and moderate Democrats who held moderate egalitarian standards and favoured protection of the environment over economic growth.

'The Cautious' exhibited 'traditional religious beliefs' (as opposed to Evangelical Christian or other religious beliefs) and tended to be equally divided in political preference between Democrats and Republicans. This group were less likely to be involved in community activities.

'The Disengaged' were more inclined to have egalitarian values along with conventional religious attitudes and be politically inactive moderate Democrats. They tended to be females from minority cultures with lower levels of education and income who favoured economic growth over protection of the environment.

'The Doubtful' were more likely to be better educated white older males with higher incomes who supported the Republican Party. They displayed a pronounced sense of individualism and generally described themselves as Evangelical Christians. Their involvement in civic activities was rated as 'average' and, like 'The Disengaged', favoured economic growth in preference to protection of the environment.

‘The Dismissive’, like ‘The Doubtful’, were more likely to be white, well-educated males with above average income with extremely conservative Republican views. ‘The Dismissive’ opposed government intervention in any form, placed a high importance on individualistic values, were opposed to egalitarianism and were actively involved in civic actions. Generally this group placed a high value on traditional religious beliefs and inclined to follow the Evangelical Christian faith.

There were also differences in perceptions of risk between respondents ‘concerned’ about climate change and those ‘alarmed’ or ‘seriously concerned’. Only 10% thought global warming would harm them ‘a great deal’ and 11% thought it would harm their families ‘a great deal’. However, most felt future generations would be harmed ‘a great deal’ (44%) as would the environment (46%). Respondents ‘alarmed’ by the seriousness of climate change exhibited more desire to change behaviours and personally engage the problem. Conversely, those ‘concerned’ about climate change tended to believe their actions would have little effect and responsibility for responses lay with the government, industry and science.

Respondents in the other four groups of: ‘The Cautious’, ‘The Disengaged’, ‘The Doubtful’ and ‘The Dismissive’ were not inclined to take or support responsive action. The attributes of these groups were similar to the attributes Langford (2002) described as: denial, disinterest and doubt, which also reflected a disinclination to take action.

In reference to reducing global warming and its effects, Maibach et al. (2009) found only 6% of respondents thought humans could reduce global warming, whereas 51% thought humans could reduce global warming but ‘were unclear if we will’. Just 13% felt personal energy saving responses would reduce global warming but 42% believed if most Americans undertook the same actions it would make a difference. However 60% believed if people in other developed nations took action global warming would be reduced.

In addition Maibach et al. (2009) identified varying responses to climate change information communication. As with the EORG (2002) study, only 18% of respondents thought they were ‘very well informed’ and 22% thought they needed a little more information about global warming. In contrast 30% of respondents

required ‘a lot more information’ and 30% wanted ‘some more information’. Yet just 12% of respondents indicated they paid ‘a lot of attention’ and 30% ‘some attention’ to information about global warming.

As far as climate change science was concerned, Maibach et al. (2009) research showed there were issues with the credibility of science. While 47% of respondents believed most scientists thought global warming was happening, 33% felt ‘There was a lot of disagreement’ about climate change amongst scientists. Additionally over half (54%) indicated they ‘somewhat trusted scientists’ as sources of global warming information whereas only 29% indicated they ‘strongly trusted’ scientists.

As with other studies, global warming as an issue was ranked below other policy issues such as health care, terrorism, social security, education, tax cuts and illegal immigration (Bord et al., 1998; Dunlap and Saad, 2001). Only 21% of respondents in Maibach et al.’s (2009) research believed global warming was an important issue although its importance as an environmental issue had increased when compared to Dunlap and Saad’s 2001 study.

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Appendix 3: Familiarisation study interview responses

Familiarisation study interviews

Familiarisation study interview 1

Participant 1

Farmer (male) from the Upper Great Southern

Farm size – 720 Ha

Enterprise – sheep / wool / meat & cattle – no cropping

Works off farm – shearer 6 months

CE: *What do you think about climate change?*
P 1: Look I think people are making a big thing out of it without really knowing what's going on.
CE: *How do you mean?*

P 1: Well the climates always changing … has always changed. I have been farming for 45 years and I have never seen one season the same as another. Sure some are nearly the same and sometimes you get a run of seasons that are wetter or dryer but there still lot a lot of difference between each year.

CE: *So what do you mean by people not knowing about what's going on?*

P 1: Well that's just it. You've got these city people and scientists and experts who have just worked out that things' have got a bit dryer and now they are worried by it. It's like they've suddenly realised that water is precious and shouldn't be wasted like they have been doing for years. But because they have never had to worry about water before they didn't care but now they are worried and they have realised that good rains during the winter is important for them as well as us. Now there's not much run off because of the drier years we've been having they have think the climates' changed and everything will get hotter and dryer.

CE: *Do you think the climates' changed while you have been farming?*

P 1: Of course it's changed. Like I said it's always changing. We have had big dry's before, back in the 1940s and the 1970s but then it's turned wet again. Who knows were it will end up? The old man reckoned the weather was different when he was young to what it was when he finished farming. But then his dad went through the Federation drought and the old man never went through a drought as bad as that and he farmed for 60 years. And that's what I mean. People don't realise that the federation drought lasted a long a time. You know it went on over 10 to 15 years but not all of the years were bad. Some years were okay but then there would be a couple of bad ones in a row. But blokes kept farming and made it through. Grandad got through ok and after a couple of years he had some more land. The depression knocked grandad around more than the droughts.

CE: *So its weather patterns that have changed.*

P 1: Yes

CE: *In what way would you say the weather patterns have changed?*

P 1: What do you mean?

CE: *Well for instance, are summers hotter or do you think winters are warmer?*

P 1: Oh right, I see what you mean. I don't know if the summers are hotter. Summer has always been hot here. Hot is hot you know. If you're out working you can't tell the difference between 40 and 44 degrees, you just know it's hot.

CE: *What about winters? Are they warmer, colder or the same?*

P 1: Yes, I'd probably have to say that in the last 20 odd year's winters seem to be a bit warmer. We don't seem to have the real cold frosts now that we used to have when I was a kid. You see it in the veggie patch with the way things grow. Most of the veggies grow all the way through winter now. We get a couple crops off now where in the old days you got only one crop.

CE: *Do you think the changes have affected the way you farm?*

P 1: No, probably not. It's hard to say because there have been so many improvements with the stock and pastures and fertilisers. I mean the changes I've seen in farming and the way we do things now is down to the clover and fertilisers we use more than the weather. No when I think about it, the things we have to do

like shearing the lambs in the spring before the grass seeds still happen at the same time they always have. You might get a week or so one way or another but on average you know that you have to start shearing the lambs by the third week of October or the grass seeds will stuff the wool up.

CE: *Anything else?*

P 1: Yes some things are different. Like the pasture seems to have a better run. You know, like the time it stops growing in the winter doesn't seem to be as long as it once was. But you could put that down to any number of things. With the dryer winters the ground isn't as saturated like it used to get but then we use a better sort of fertiliser now than we did when I started farming. When I started we only had super phosphate and that went on everything, crops, and pastures. We'd put a hundred pounds down the tubes with the crop and 140 lbs on the pastures year in year out. It worked well for a while especially when we got clover but I think in the end it wasn't doing that much good. Now we use super potash, muriate and nitrogen through the year, which has given a big kick to everything, so who knows. We go back into a wet cycle then everything might go back to the way it was.

CE: *What do you think is causing the changes?*

P 1: Anything could be doing it. You get those eruptions of gases on the sun and volcanoes erupting. That will make it hotter. They say when Mount Pinatubo erupted, the ash in the atmosphere blocked the sunlight and the average temperature dropped 3 degrees for a couple of years.

CE: *Where do you get your information about what's happening to the climate from?*

P 1: The newspapers and T.V. You might see something on the (ABC) news or Lateline.

CE: *Do you discuss the changing climate with friends or family?*

P 1: Don't talk about it much with the family. The wife's not really interested. Sometimes we talk about it in the (shearing) shed at smoko or lunch. We don't talk about climate change much. Usually it's about how the weather is panning out or if it's been really dry or wet.

CE: *What do you think about the melting of the ice at the north and South Pole?*

P 1: I don't know, I probably haven't really thought about that. I've got more things to worry about here than ice melting at the poles.

CE: *So you wouldn't say it's a concern for you?*

P 1: No I don't think so. Look the earth's been covered by ice and now it isn't. Who can say that in another thousand years it will be covered again? I can't worry about melting ice on the poles. It's not important to me. What I worry about is what is coming over the hills and when it is going to come. Do they really know what's causing the ice to melt?

CE: *Scientists say that the earth's average temperature has increased by 1 degree in the last 100 years which has lead to the melting?*

P 1: What! A one degree increase is the difference between the ice at the North Pole melting and not melting. That's a bit hard to imagine. I mean a one degree increase in temperature; it's not something you are going to notice.

CE: *Then what do you think about scientists warning that climate change could be a serious threat to agriculture in the future?*

P 1: I don't know. Probably anything could be a serious threat in the future. I think we (farmers) have more to worry about that than the climate. Things like the prices we get for our wool and meat and the costs going up for fertiliser and fuel. We are getting the same money for our wool that we got ten years ago and beef prices aren't much better. But fertiliser and fuel keeps increasing in price every year. No prices and costs will push us out of farming before any climate change. That's the thing. In the old days farmers used to be valued by the government and city people. We were important to the country; we put food on the table and brought in export dollars for the country, but not now. No I don't think the average city person cares about the farmers or even cares about were their food comes from so long as they can walk into a supermarket and it's there and it's cheap. The government's the same. As long as we keep paying our taxes they don't care.

CE: *Just returning to the subject for a moment. On the subject of scientist and science, what are your thoughts about science and the role it has in climate change?*

P 1: I haven't really thought about it. I suppose it's the scientists that are saying climate change is happening and is a problem. I guess that's the job some of them have chosen.

CE: *Do you think that they could be right?*

P 1: Look they might have noticed some changes but who is to say they are right or not. Scientists like to think they are important and they know a lot of stuff that the rest of us don't but I think we know more about other parts of life than they ever will. The trouble is they get in and just look at just one thing and ignore everything else. So they might be right about what they were looking at but overall they could be very wrong. Look at the cane toad. That's what people forget. Sometimes science can cause more problems than it solves. There's a big difference between something done in the laboratory and when it's done in the paddock.

CE: *But hasn't the work of scientists been beneficial to agriculture?*

P 1: No I wouldn't totally agree with that. Sure science has come up with a few things but most of the real advances in agriculture have been because of ordinary farmers getting out there and trying to work some things out. Farmers are always trying to come up with better ways to do the work or better tools to do the work with. Nine times out of ten, I bet you that the good idea a scientist has come up with he got from a farmer. They (scientists) just wait around for the farmers to do all the work and when something looks like it's going to work they walk in and take over. Every time scientists try to do something themselves, it costs a lot of money and comes to nothing. Look at the robotic shearing machine they spent years and years trying to develop and after all the time and money spent it still didn't work.I haven't got anything against scientists because they have done some good things but they big note themselves and carry on as if they are the only ones who can do anything.

Interview concluded

Familiarisation study interview 2

Participant 2

Farmer (male) from the Great Southern

Farm size – 3200 Ha with 1600 ha leased

Enterprise – sheep / wool / meat, prime land, grain and hay production

C E: *What do you think about climate change?*

P 2: To tell the truth I am a bit sceptical about it. If you think about it, the climate has been in constant state of change for millions of years and now suddenly it's become a problem.

C E: *The issue scientists say is that greenhouse emissions caused by human activities are contributing to it*

P 2: Well I can't argue with what the scientists say because that's what they do, but I find it strange that the main causes of climate change are humans. Especially when you think that there are other causes, like solar storms, the earth's trajectory around the sun. I don't think we know enough yet to say if humans are the main cause of climate change or if it's something else.

C E: *Do you think that there have been changes in the climate while you have been farming?*

P 2: Again, I would have to say that the climate is always changing. The climate is dynamic and as a result weather patterns frequently change. In the 54 years I have been farming I have seen many different seasons. Seasons with above average rain, dry seasons, late breaks, early breaks, early finishes, soft finishes, no rain, you name it I have seen it. The other point I would make is that each type of season seems to fall into pattern over a couple of years. So you will have two or three seasons with good rains and then you might have a couple of seasons that start later with less rainfall during the autumn and winter but finish with good money rains in the spring. Whatever happens, you adjust to the pattern and when you are getting use to it and think it will continue the pattern will change and a lot of the time it will be the opposite to what had been happening.

C E: *Where do you get your information about climate change from?*

P 2: Mainly the papers and the news and current affairs show on the ABC. I won't watch the commercial stations news and current affairs. What they present isn't news.

C E: *Are there any other information sources you have used?*

P 2: I have read a few industry reports. The boy (eldest son) has shown me a few things on the internet.

C E: *Do you discuss the changing climate with friends or family?*

P 2: Sometimes. My son and I have talked about it a bit. I have had a few stoushes with friends who think farming is one of the major causes of emission problems in Australia. They are all high and mighty about the emissions from farming, but they don't think about the emissions they cause.

C E: *To look at it in a broad view what do you think about glaciers and the ice pack melting at the poles?*

P 2: This goes back to what I have said before. The climate is dynamic. Remember it had to get b….. cold in the first place for the glaciers and polar ice caps to form. People forget that the glaciers are relics of the ice age.

C E: *So it doesn't concern you?*

P 2: No, I can't say it's a major worry.

C E: *Then what do you think about scientists warning that climate change could be a serious threat agriculture in the future?*

P 2: Again I would have to say I am sceptical. The scientists themselves can't agree as to what will happen or when it will happen. I believe that at the end of the day farmers and for the matter the human race will adapt as changes happen. To be honest, there is not a hell of lot else we will be able to do.

C E: *Do you think science could have a major part in the adaptation to climate change?*

P 2: Science will no doubt have a part to play but the ordinary person will have to do their bit and not rely on science to pull them out of trouble. Don't get me wrong when I say that I am sceptical about climate change. That doesn't mean I am

sceptical about science especially as far as agriculture is concerned. You only have to look back at 2006 in what was a terrible season. If science and research hadn't developed the new cropping technologies we wouldn't have got crop in. As it was we got a crop off with a yield only 20% below our average.

What I am wary of with research and this push for technologies to adapt to climate change is the accountability of the researchers. Farmers are contributing dollar for dollar to R&D and every year there seems to be more researchers with the hands out looking for funding. As a farmer, I don't mind contributing to research but I want to know what I am getting for my money. My concern is that climate change will be an excuse for some researchers to put the hand out and guarantee themselves a job.

C E: *What do you think about the governments' position on mitigation and adaptation policy?*

P 2: You could read that as good election platform with opportunities for new taxes.

C E: *Is that scepticsm or cynicism?*

P 2: Take your pick. Rudd wanted a policy to make sure he could get into power and he was told climate change was the ticket. Rudd said that he would do something about climate change but never actually knew what he was going to do. When he was elected he had to do something so he got hold of Garnaut who has never done farmers any favours and told him to come up with something. Now we have all this talk about mitigation and carbon taxes and the rest of it. Well we know what that means. If a climate change tax or carbon tax or whatever they are going to call it comes in, there will be only one part of population that's paying for it and that will be the farmers.

C E: *So you don't trust the government?*

P 2: I suppose there are good people in politics but I think in the end it's probably the system that lets them down. The trouble is the short term that the government has between each election. It doesn't give enough time to take on the tough issues and come up with a good policy. The government has got to grab headlines with policies that offend the least number of voters as soon as it can to keep it in office.

C E: *Do you think rural communities have been treated fairly by state and federal governments?*

P 2: To be fair, they don't have a lot of choice. You see it's a question of numbers and there aren't many of us left out in the country. I'm on the shire council representing a rural ward and the fact is a fifth of shire ratepayers being the farmers pay rates that make up two thirds of rate revenue. Every time the rates are increased my phone rings off the hook. But there's no other way to do it. It's a bit the same with the government. The money has to go where the numbers are.

What the government needs to be careful not to do is undermine our competitiveness in the markets. Especially if other countries are not doing the same thing. That could be an issue. If the government rushes in with climate change taxes and regulations and we have to bear the cost while our competitors don't. To tell the truth, I think we (farmers) are better off without any government support. Every time the government gets involved, the paper work and due diligence goes off the scale. It would be good if they could leave us alone and just let us do the job.

Interview concluded

Familiarisation study interview 3

Participant 3

Farmer (male) from the North eastern agricultural region

Farm size – 10000 ha

Enterprise – grain / pulse production

C E: *What do you think about climate change?*

P 3: I haven't really thought about it. I have just been through four years of drought and no income.

C E: *Do you think the climate is changing?*

P 3: Yes, I suppose so. The last four years were certainly a change from what I was used to.

C E: *How bad were those years for you?*

P 3: Pretty bad.

C E: *Did you make any income? Did you get crops in and not harvest them or just have poor harvests?*

P 3: No things were pretty serious. The first year I cleared out all the sheep straight away. Wool and meat prices weren't good so I didn't get a lot for them, but I would have spent more keeping them. I put a crop in dry the first year and managed to get some seed back. The second year I waited for rain before sowing but it came late and there wasn't much of it so I left the gear in the shed. The last two years were more or less the same. The only income I made was from doing a bit of work around the place. I didn't make a cent of the place, but I still had bills.

C E: *How did you manage to stay farming?*

P 3: I got EC (Exceptional Circumstances) assistance in the second year. That's all that got me through.

C E: *Did you have any problems getting it?*

P 3: No. it was pretty straight forward. All my records and paper work were in order and the district was declared so there weren't any real problems.

C E: *It must have been a stressful period for you?*

P 3: Not really, I don't let stress get to me.

C E: *You weren't stressed during that time?*

P 3: No. As I said I don't get stressed. It used to get to me but after I had some issues ten years ago I learnt not to get stressed. There's no point stressing over something you can't control. I can't control the weather so I concentrate on what I can control. It's the same with this year (2008). No one thought this year would turn out the way it did. I couldn't make it rain but when the rains came early I could put the crop in and give myself a chance. It's turning out all right.

C E: *So what you are saying is that it was management that got through?*

P 3: Yes. I wouldn't have got the EC assistance if my management practices weren't up to scratch and the bank wouldn't have backed me in for this year if they thought I wasn't a good manager.

C E: *Would you say that what you experienced in the last 4 years could be linked to climate change?*

P 3: No, I wouldn't agree with that. Sure those years were out of the box as far as droughts are concerned but other areas have gone through the same in the past. I was shearing when Perenjori went through 5 years of drought in the 1970's. We had a full shearing run there but after two years there wasn't enough sheep left to continue the run. But Perenjori came out of it in the end.

C E: *What do you think are the causes of climate change?*

P 3: I think it's just natural. We (humans) aren't helping but I don't think we are a major cause of it.

C E: *Where do you get your information about climate change from?*

P 3: I don't know. I don't watch Television and I don't get the paper regularly. On the odd occasion I have seen some articles in the paper. I have read a couple of articles about it in magazines in the doctor's surgery.

C E: *Are there any other information sources you have used?*

P 3: No I haven't really gone looking for information about it.

C E: *Do you discuss the changing climate with friends or family?*

P 3: No. I don't see the family often. I live on the farm and they have all moved.

C E: *What do you think about scientists warning that climate change could be a serious threat agriculture in the future?*

P 3: It could be a serious threat, but there's probably as much chance it won't be. The weather or climate, whatever you want to call it is only one part of farming. There are a lot of other factors that can affect the bottom line. Sure you have to grow the grain to sell it but then you have to have somewhere to sell it for a decent price. I'm lucky this year. I sowed a crop with fertiliser I bought three years ago at a third of the price it is now and I look like selling the grain into a bumper market. Things could be a lot different if I was only getting half the money for the grain.

C E: *Do you think science could have a major part in agricultures adaptation to climate change?*

P 3: I think it's more about scientists and farmers working together. Scientists and researchers have some good ideas, but it has been the farmers who work out the bugs and make it work in the paddocks.

C E: *What do you think about the governments' position on mitigation and adaptation policy?* (*Participant did not know anything about the governments' position on mitigation and adaptation policy*)

C E: *This talk about a carbon tax on greenhouse emissions and carbon trading*.

P 3: No. I don't really know anything about that.

C E: *Do you think that government's future climate change policies will treat farmers fairly?*

P 3: I think they will. We don't earn the income for the country that mining does but we still make a big contribution. It will be in the country's interest to look after us.

C E: *So you would say you trust the government?*

P 3: I would have to say that. I wouldn't be farming if it wasn't for the EC policy. And not just me. There's a lot of blokes around that would be off their farms if it wasn't for EC assistance.

Interview concluded

Familiarisation study interview 4

Participant 4

Farmer (female) from the Northern Agricultural Region

Farm size – 1200 ha

Enterprise – cattle production – feed lot

Partner works full time off farm. Participant works part time off farm.

CE: *What do you think about climate change?*

P 4: I'm quite concerned about it. There is a lot of talk about it but no one is doing anything.

CE: *Have you noticed changes in the climate where you farm?*

P 4: Definitely, there have been some big changes.

CE: *What have the changes been?*

P 4: We have a lot less rain now compared to when I was young. Dad put in interceptor banks on all the flats because of the water logging during winter and salt problems. The last 10 years dad harvested some of the best crops on the farm of the flats so he bulldozed a lot of the banks flat two or three years ago to making cropping easier.

CE: *Have there been other changes?*

P 4: Yes we seem to have more really big storms now. I thought I might have been imagining it but dad has been here through the last couple we have had and he said he hadn't seen storms like that.

CE: *Do you think that the changes are part of climate change?*

P 4: Yes, definitely. It's happening everywhere, across Australia and the world. You see it on the news all the time. You only have to listen to the locals who have been in the district for a long time. After the last storm, no one was saying that there had been a worse storm before that. The oldies kept saying that they had never seen a storm like that before.

CE: *What do you think are the causes of climate change?*

P 4: I think its pollution and greenhouse gases. I have seen an 'Inconvenient Truth' and other documentaries and the pollution human's cause is the only factor that has made a difference to temperatures and the amount of carbon in the atmosphere.

CE: *So you would agree with the scientist's warnings that climate change is a serious threat to the future of agriculture?*

P 4: Yes I think they are totally right. If the climate keeps changing the way it has there mightn't be farming in this area in fifty years time. Something has got to be done.

CE: *Where would you say you get your information about climate change from?*

P 4: From the news (T.V. ABC) and the occasional documentary. I have seen Gores' "Inconvenient Truth" and I have been to a few sites on the web.

CE: *Are there any other information sources you have used?*

P 4: I have been to a seminar on climate change.

CE: *Do you discuss the changing climate with friends or family?*

P 4: Yes, I have discussed with mum and a few of my friends. I don't talk about it with my husband. He doesn't believe in it and refuses to talk about it.

CE: *Do you think science could have a major part in farmer's adaptation to climate change?*

P 4: Yes but farmers will need to be a part of it. Science can't go off and decide what is needed. It's got to be a joint effort.

CE: *Does that apply to the government as well.*

P 4: We should all be doing something. It isn't just the government's responsibility. It's the communities and the individual.

CE: *Are you doing anything about it?*

P 4: I'm trying to. The trouble is, it's really difficult, especially for farmers and people living in the country. You try not to make unnecessary trips to town and if we go to Perth, I try to make it for a couple of reasons. Unfortunately sometimes we don't have any choice. There is a lot I can do but some things take extra effort or I don't have the time to do it. I am sure there are a lot of other things I could do but I don't really know what they are.

CE: *What do you think about the governments' position on mitigation and adaptation policy? Like a tax on greenhouse emissions and carbon trading.*

P 4: I don't understand carbon trading but I think a tax on greenhouse emissions is a good idea. It's only right that if a business or the individual does something that causes greenhouse gases they should pay for it.

CE: *By what you are saying you would include farming and the agricultural industry in that?*

P 4: Yes I would.

CE: *Does that worry you in relation to your future on the farm?*

P 4: Of course it worries me. But I am more worried about what could happen if we don't do something about climate change. If farming is contributing to climate change, then we have to find another way to farm. We need to work with the scientist and researchers to come up with alternatives.

CE: *So you think science has a key role to play in coming up with solutions for agriculture?*

P 4: Yes. Research and development has been a key part of agriculture and farming. Certainly there have been some issues but generally research has been a great benefit to farming.

CE: *Do you think that the government's climate change policy will take the needs of agriculture and farmers into account?*

P 4: I don't think the intention of the policies would be deliberately unfair to the farming community. There trouble is that a policy could be beneficial for the country as whole but it might not be beneficial for rural people.

CE: *So do you trust the government to do the right thing?*

P 4: I would hope that the government does the right thing. My biggest concern is that climate change becomes political and the political parties use it to try and get elected. Climate change is one issue that should not be treated as political.

Interview concluded

Familiarisation study interview 5

Participant 5

Agronomy consultant (male) Northern Agricultural Region

CE: *What are your thoughts on climate change?*

P5: Geez. That's straight to the point. What do you mean? If it's happening or not?

CE: *Yes that or whatever you may think about it.*

P5: Well yes I think its happening and its happening a lot faster than people think.

CE: *What do you think is causing it?*

P5: We are. Humans.

CE: *So it's not a natural occurrence?*

P5: To be fair I would have to say that there could be some natural causes but on the whole I think it's mainly down to us.

CE: *Have you noticed any changes in the climate over the years?*

P5: The opening breaks seem to be getting later and it hasn't been as wet on the break or during the growing season as it was when I was a kid.

CE: *Would you say that your farmer clients have similar opinions?*

P5: Oh no way. If they knew that I thought that they would string me up (laughs). Seriously a lot of them think that it's a load of B S. to tell the truth I can't say I blame some of them considering where they farm. Some of those places out in the eastern and northern eastern Wheatbelt are in a pretty variable even marginal climate zone. Sometimes it's hard to tell if they are going to get a crop. That's the thing; it can turn around very quickly in those places. At times I wonder how they can keep farming there but they have their systems and they know the risks and even though they might have a couple of bad seasons the next thing you know, they have a tax problem.

CE: *So you would agree with the scientist's warnings that climate change is a serious threat to the future of agriculture?*

P5: I think climate change is going to have some serious challenges for agriculture but I wouldn't give up hope. There is a lot of work being done on breeding plants more tolerant to dry conditions and shorter growing season wheats. Plus there is research that is showing a big potential for carbon in the atmosphere to provide an additional fertilisation source for plants. I read a paper about it a couple of days ago actually. The increased levels of carbon available for plants could offset any yield deficiencies caused by 10 to 20% decrease in rainfall. In the end farming might change a great deal from what we know as now but I think we will still have a strong ag industry in the future.

CE: *Where do you get your information about climate change from?*

P5: If I have time I go to the climate change web sites and the science journal sites on the net and I have had a few (research) papers come across my desk.

CE: *Are there any other information sources you have used?*

P5: Not really. If there's a documentary or discussion about it on T.V., I will try and watch it.

CE: *Do you discuss the changing climate with friends or family?*

P5: Yes, I have had some discussions with the family and some of my friends. It's not an ongoing topic, but every now and then with a couple of glasses of red.

CE: *What do you think about the governments' position on mitigation and adaptation policy? Like a tax on greenhouse emissions and carbon trading.*

P5: That could be a big concern. I've heard a bit of talk about a tax on farm emissions and carbon trading being a way for farmers to offset the tax and make some money out of it. But I don't know. The government would need to get it right.

CE: *Would you trust the government to do the right thing?*

P5: That's a tough question. I don't know if I would or not. It depends if there is someone else they want to keep happy, like the miners or coal industry. Agriculture doesn't have as much political pull as some of the other industries that could be affected by an emissions tax. By rights the government should probably do the right thing but who knows?

CE: *Bearing that in mind do you think the government's climate change policy will take the needs of agriculture and farmers into account?*

P5: It would have to be the same answer as before. It's really a question of should, could, would. The biggest problem for rural people is that there aren't enough of them in WA. Of course the government should take the needs of agriculture into account, but will it. I don't know. You would hope so wouldn't you?

CE: *Just one question about your company and its approach to climate change. Is the company you work for starting to Incorporate climate change into its strategic planning?*

P5: No, nothing I have seen or heard of.

CE: *Nothing at all?*

P5: No, absolutely nothing. I don't think the bosses at the top are too worried about it. That's if they know about it.

Interview concluded.

Familiarisation study interview 6

Participant 6

Senior financial officer (male) Northern and Central Agricultural Regions

CE: *What are your thoughts on climate change?*

P6: If you had asked me that 2 months ago I would have said that it wasn't happening. Now I think maybe it is.

CE: *You still don't sound totally convinced?*

P6: No I am not totally convinced but I do think there is more chance that it is happening than it isn't.

CE: *What do you think may be causing it?*

P6: That's something I can't make up my mind about. It seems like no one really knows.

CE: *What do you mean by that?*

P6: Well you watch the news and one day there's scientists saying that climate change is caused by humans and then you read in the paper that another scientist thinks the pull of the sun or something is the cause. If I had to say what was causing it, I think I would say we were the cause.

CE: *So it's not natural or a normal climatic cycle?*

P6: It could be. I'm not a scientist, I couldn't say if it was natural or not.

CE: *Do you think it could be a threat to agriculture in the future?*

P6: If it is going to be as bad as some scientists say then it could be a threat. But as I have said before, no one really knows.

CE: *Where do you get your information about climate change from?*

P6: Mainly from the news. I recently saw “An Inconvenient Truth”. Have you seen it? That made me think.

CE: *Are there any other information sources you have used?*

P6: No, I can’t say there are.

CE: *Do you discuss the changing climate with friends or family?*

P6: I have been discussing it with the family since we watched the “An Inconvenient Truth”. We have all seen it. I have spoken to a few friends and (work) colleagues as well.

CE: *Do you think science could have a major part in helping farmer’s adapt to climate change?*

P6: Yes. What’s important though is that funding is available for the R&D, and the government and farmers support it.

CE: *Have you spent a lot of time in the country as a financial officer?*

P6: Yes. With one bank or another I have had nearly 20 years of country work.

CE: *Over the years have you noticed any change in the climate in the areas you work in?*

P6: Some districts have got dryer. Then there are other places that still seem to be the same. It’s hard to make a judgement because I am only in a place for a couple of days every 4 or 5 months. But from what I have seen I would say that in some areas the climate is very different to what it was 20 years ago.

CE: *Do you think the changes in climate could be the result of climate change?*

P6: It could be in places. Some of my older clients say that their farms have had consistently less rainfall over the last 40 or so years compared than they used to have. You know these old blokes. They have records going back to their fathers and even their grandfather’s time. I have seen some of those records and there is a definite drop in rainfall in the last 30 – 40 years. Then I have seen other rainfall records on farms 50 ks down the road and their average rainfall hasn’t changed in the last 90 years. It’s hard to know.

CE: *Do you see any potential issues for clients with the government's proposed tax on emissions?*

P6: I haven't heard much about it, so really I can't comment.

CE: *What about carbon trading?*

P6: No, I only have a sketchy idea about carbon trading. A few people at work have been discussing it, but I haven't really looked into yet. From what I have heard there could be some possibilities for farmers to make some money out of it, but I don't know enough of the detail to make a judgement.

CE: *Do you think the government will consider the needs of farmers when it comes to setting up the climate change policy?*

P6: If I was a betting man, I don't think I would bet on it. You know, you would hope the government would look out for farmers but …

CE: *What do you think your clients opinions of climate change are?*

P6: I haven't had many discussions with my clients about climate change. I have one client who is a full bottle on it and believes it. Then there's a couple of other clients who think it's nonsense.

CE: *Just a question about your company and its approach to climate change. Is the company you work for starting to incorporate climate change into its strategic planning?*

P6: No, not as yet. Not that I have seen or know of.

CE: *Climate change could have some pretty serious implications for the agri-finance industry.*

P6: Yes I agree, but it isn't on the radar yet.

Interview concluded.

Familiarisation study interview 7

Participant 7

Livestock exporter representative (male)

Resides in Perth

CE: *What do you think about climate change?*

P7: Not much.

CE: *You don't think climate change is occurring?*

P7: Not the type of climate change the government and scientists are going on about.

CE: *Climate change caused by human activities.*

P7: That's right. I don't question that the climate could be changing. You would be stupid to think that it doesn't. What I question is the presumption that humans are the cause. That is just not right. There is no definitive proof and historically the climate has had no trouble changing without human intervention.

CE: *You disagree with the science?*

P7: Yes I disagree with the science but more than that, I think the most of the science about climate change is pretty half baked. Okay there has been some ice melting because apparently the average temperature of the world has increased. I am fine with that. But tell me how the scientists can justify saying that humans have caused it. It is almost mythological.

CE: *Have you noticed any changes in the climate?*

P7: No. Overall I don't think the climate has changed much. Don't get me wrong, there are fluctuations in the climate and weather but I wouldn't say there has been a dramatic change. The trouble is people only remember the last few years when it's been dry. So they get worried about it. Give it a couple of years when it turns wet and people will forget about the dry spell.

CE: *Where do you get your information about climate change from?*

P7: There's a few sites on the web that give a balanced perspective of the changes in climate and the polar ice caps melting. They show that climate change is something that has always happened without causing any serious problems for the world. There is a few of us who email articles or links to each other.

CE: *Are there any other information sources you have used?*

P7: No, I can't say there are. It's in the news every other day. You can't open a paper or watch T.V. without another scientists or labour politician going on about the latest climate change research and how if nothing is done the world will end. I won't read about it or watch it.

CE: *Do you discuss the changing climate with friends or family?*

P7: No, that's a no go. My wife is a bit of a greenie so we have agreed not to discuss it.

CE: *Would I be correct in understanding that from your earlier response you disagree with the government's position on climate change as well?*

P7: The government, that's the federal government, Rudd and his little band are working hand in glove with the scientists in promoting climate change. That was the crap the labour party ran past the city voter who wouldn't know any better. The only time the average city person worries about the weather or climate is if they need an umbrella for work or if it's going to be fine on the weekend.

All Rudd and the labour party had to do was trot out some white coats who tell the voter that the climate will change and stuff their lives and their children's lives up if nothing is done about it. To stop it from happening all they have to do is vote labour and K. Rudd will fix it. Hey presto the voters bought it and K.Rudd got the job. Look at the coverage of climate change science when Rudd was elected. Every pasty faced researcher and scientist that has something to say about climate change were on the news and in the papers every day. My theory is that Rudd is using climate change to cover up the fact he and his government don't have any real policies.

CE: *You feel pretty strongly about that?*

P7: You bet I do. What the (Federal) government is doing is a b….. travesty. There are plenty of more important issues out there for agriculture and the country than climate change. The problem Rudd has with the other issues is that he needs real policies to do something about them; he knows he needs real solutions. But guess what, he doesn't have any. That's where climate change comes in. it's a problem that can't be fixed but you can put on a great show of trying to fix it. Rudd and his greenie mates better hope that the scientists are wrong. Because if by some chance scientists have actually got it right and climate change is a serious problem, there's

no way Rudd or the Federal labour government are going to make one iota of difference.

CE: *So you would disagree with the view of scientists that climate change could be a serious threat in the future for agriculture?*

P7: Yes, I would disagree with that view. That's a bit of a stretch isn't it? They might as well say that meteors represent a serious threat to agriculture in the future. There's probably more chance of a meteor hitting than climate change causing any major calamity. The trouble is people don't look below the surface of anything that gets into the papers or on the TV. People should work out what climate change really means for science and the researchers. Climate change will be funding boom time for any scientists that have nothing meaningful to do. They (scientists) are lining up ten deep already with their hands out and yelling climate change at the pollies.

CE: *What then do you think about the proposal for a greenhouse emissions tax and carbon trading?*

P7: An emissions tax. It's just another excuse for a tax and the people who have to pay will be the ones who can least afford to. I bet the industries that should pay will get a free ride because of jobs and the economy and industries like agriculture will be shafted. Its all about economic and political rationalism. If the coal or mining industries have to pay a tax they will tell the pollies it will cost jobs. Jobs equal votes so there is no way politicians will risk votes. That means it will be the voters that don't count who will cop the tax.

CE: *What about carbon trading?*

P7: I wish I knew. I have tried to find out how carbon trading works but I still don't know. Tell me how can you trade a commodity that no one can see. How do you work out what it's worth? I don't know. It's confusing.

Interview concluded.

Familiarisation study interview 8

Participants 8 & 9

Participants: Aboriginal elders

Live in the upper great southern

Contribute to managing a community farm

The subjects were interviewed together at their request. Participant 8 had lived and worked in the district all of his life. His working life began with helping his father clear the land and do seasonal work for the white farmers. While he had some rudimentary schooling most of his childhood was spent helping his father. He learnt to read and write when he was 52. P8 began full time work three weeks before his 14 birthday and was shearing for 6 months of the year by the time he was 15.

Participant 9 was born in the Avon region where he spent his early childhood and was schooled. His was educated at a mission school from between the ages of eight and 17. After leaving school he began working for farmers through the Avon region. Later he married a woman from the Upper Great Southern district and moved there to make a life. He continued to work for farmers until in his early forties he moved to Perth and took up employment with various indigenous organisations and government departments. He retired at 60 and with his wife and family moved back to the country. Since his retirement he has been an indigenous consultant attached to various catchments groups in the Avon and Great Southern regions.

CE: *What do you both think about climate change?*

P9: The climate has changed a lot around here. Compared to what it used to be like. When we were shearing in the winter and spring, it was always raining. You couldn't get dry sheep. Now the boys only lose a couple a days a month. Sometimes we wouldn't get dry sheep for a month.

P8: There has been a big change. When we started out we would struggle to shear a full week straight at a shed in August and September.

P9…and October.

P8: The first couple of weeks of October were always wet. We would be rowing (arguing) with the boss about wet sheep.

P9: The boss was always saying they were dry and we'd be ringing water out of the wool.

P8: Now a day's the boys got to take their own water to the shed to get wet sheep.

P9: The sheep were never really dry. But you would have to shear them in the end.

P8: Or you would never finish the shed.

P9: Some years we would be working in 4 or 5 sheds during the week. The farmers would get a few sheep in and keep the dry and then we would go and shear them and when we shore that shed out, maybe a run, a half a day we'd go to the next shed and finish the day there.

P8: Or go and finish the day and another shed after that.

CE: *That must have been hard?*

P8: Moving around was all right. It wasn't getting paid that was a bit hard.

CE: *How do you mean?*

P9: We didn't get paid up until we finished a shed. You could go 6 weeks without finishing a shed.

CE: *How did you manage?*

P8: We could always get a sub off the boss.

CE: *What is a sub?*

P8: That's like an advance on what you were going to shear or the time you 'rousied' (Shed hand) in the shed.

P9: I always tried to get a sub on some of my tally. You had to watch it. Some blokes got so much subbed, they didn't get a cheque when the shed cut out (finished shearing)

P8: (laughing) Remember …. He was a silly b……. He'd get so many subs he'd have to go back after the shed cut out and work them off for the boss.

CE: *It must have been tough?*

P8: No it wasn't that bad. We would always get by. In those days we didn't need a lot of money, not like the young ones now.

CE: *How did you manage?*

P8: See we used to camp at the farm when we were shearing there. While we were there the shearer was entitled to a sheep (for meat) a fortnight and the farmer, they always had chooks and milked cows. We did alright. Fresh meat, eggs and milk.

P9: The only things we needed beside that was some flour for the damper and some tea and sugar.

P8: and onions.

P9: For the roo stew.

CE: *So you could get some 'roo's?*

P9: All the time and rabbits.

P8: Possums too and echidnas and turtles

P9: All sorts of bush tucker. The kids and the women would go into the bush during the day and find berries and yams. Good bush tucker.

P8: Quandongs and sandalwood seeds.

CE: *You sounded like you settled in?*

P8: We did. We never knew how long we would be at a farm. Like we'd get to …… farm and if we got a good run we could cut the shed out in 3 weeks. But with wet weather, most times we would be there for 4 or 5 weeks.

P9: Remember when we were shearing at …. in 1964. We did 3 days shearing in 3 weeks and in the end he told us to go and come back when it stopped raining.

P8: He was worried we'd eat all his sheep before we shore them.

CE: *So you would say you have noticed a change in the climate or weather here in the last 30-40 years?*

P8: Yes. In the old days there was always rain in the autumn, usually sometime in March or April. There were always plenty of mushrooms in the paddock when we started ploughing. I never took a cut lunch to work when I was driving the plough. I had a billy and a plough disk. Used to light my fire, put the billy on and jump of the tractor and pick mushrooms all morning for my lunch. When I stopped for lunch used to cook the mushrooms on the plough disk. Nowadays I don't think some of the

young blokes know that mushrooms used to grow in the paddocks. They think you can only get them from a shop.

CE: *So there is less rain in the autumn. What about winter? Is there less rain then as well?*

P8: Yes, a lot less rain. You look around at the hills here. There's gullies' running down the hills and across the paddocks. How do you think the gullies got there.

P9: (pointing at a nearby hill) There used to be a lot water coming down that hill in the winter and it would run all winter and every winter. You only see those gullies run every now and then now.

P8: (to P9) You know that gully that runs out of (names a local hill landmark) down to the road.

P9: Yes.

P8: We camped up there during the war (World War 2) when dad came home on leave from the army. Any way when his leave was over and he had to go back he was walking back to town to catch the train and he had to cross that gully. Well blooming heck the gully was 5 feet deep and 6 foot wide and the water was up to the top fairly rushing down. Well dad tried to throw his kit bag across first so he could swim it, but the kit bag landed in the water. Well he had to chase the kit back bag down the creek for miles. He didn't get it until (names a local crossing) …. That's about 12 miles away you know. Poor old fella. Any way you never see that gully running like that now.

CE: *Do you think it has got warmer during the year as well? Do you think summers are hotter now?*

P9: It's a lot hotter now in the summers. The sheep out in the paddock show you that. In the old days the sheep used to camp out in the sun in the middle of the day. They only camped in the shade when it was really hot. Now the old sheep are looking for the shade and 10 - 11 o'clock in the morning and they don't move out of it until real late in the afternoon.

P8: Yes the boys do some summer shearing now and you grab a sheep at lunch time that's been standing outside in the yards in the morning and the wool is really warm.

Before you drived your hands into the wool on a sheep in the middle of the day and it would be cool to touch.

CE: *What about the winters? Have you noticed a change?*

P9: The winters were a lot colder before.

P8: By jingo it used to be cold. Not only the mornings, the whole day.

P9: You were careful who you went and drove a tractor for. You stayed away from the tractors with no cabs.

P8: The cabs didn't make much difference. The only warm place was the hub between your legs. You'd be sweating on the inside of your legs and the rest of you would be freezing.

P9: I'd build a fire in the paddock and get off every couple of laps and stand in front of it to warm up.

P8: When I got home at night, I would stand so close the fire that my clothes would start smoking, but I still didn't feel warm.

P9: I noticed the difference when I came back here after 20 years away in Perth. We moved back at the start of winter and I was telling the grand kids how cold it got and how they didn't know what cold was living in Perth. Any way that first winter back I kept thinking that it wasn't as cold as it used to be. The kids thought it was. But Perth doesn't get cold like here. But after being back here a while I still don't think it gets a cold as it used to.

P8: You are right. Mum runs around stoking the fire up at night and I sit on the lounge in a T shirt. Half the time I don't worry about wearing gloves down the farm in the mornings in the winter. In the old days you always bought a pair of good rabbit skin gloves before winter. If you didn't wear them you couldn't feel your hands after a while.

P9: I'm the same now. Most of the time I take the 'quad' (4 wheel All Terrain Vehicle) out in the mornings to go around the sheep, I don't bother with gloves. I can remember riding a horse around the sheep in the winter with two pairs of socks on my hands and still couldn't feel them.

P8: Remember some mornings the reins would be so stiff with the cold that if you bent them sharp they would crack. No I don't think its as cold now in winter as it used to be.

CE: *What do you think could have caused the change in the climate?*

P9: Look around you (points to the paddocks). Before the white man came this was all bush, the whole lot of it. Then the white fella came in and knocked it all down, all of it, even where he couldn't grow any crops or run any sheep. He knocked it down without thinking about it. He wanted the land to look like what he was used to. Back in England they didn't have bush like Australia. He didn't understand the bush. He wasn't part of the bush. He didn't want to be part of the bush. So he knocked down and burned it. Took away the bush tucker and drove the kangaroos and possums and all the other good tucker away.

P8: Yes. Knocking down the bush made the ground warmer and the big trees, they would bring the rain. There's not enough trees to bring the rain now. The old people when they lived here in the old times were never hungry or cold and always had shelter. They only took what they needed. Never took any more. One family got a kangaroo; they shared it with everyone. Gave the old fellas first choice then everyone got a feed. When they went out hunting they knew how many kangaroos they needed. Once they got that number that was it. They didn't kill any more. Same with the bush berries. All the women and children would go out and get the berries and yams and hunt down a possum or goanna or something like that, like an echidna

P9: Yes echidna. They loved eating echidna. But there was plenty around, not like now. There was plenty of everything because the people only took what they needed and nothing extra. But the white man he didn't think about why the old people had left everything is as it was. He didn't ask the old people. He just thought they were stupid. But the old people left everything the way it was because they knew everything in the bush had a purpose. Every tree, bushes animals everything was there for a reason. The old people knew why. The trees the bushes, the birds, insects, animals, all of them kept the country balanced. Kept it so there was always plenty food for the animals and birds and the people. No one and nothing ever starved or didn't have shelter. The people knew they were part of the bush, the same as the plants and animals.

The aborigines' lived in Australia for 40,000 years. That's saying something. For 40,000 years they respected the land and looked after it and only took what they needed and the land gave them what they needed. Now, look at it. The white man has taken 200 years to destroy what the aborigines looked after for 40000 years. The white man took more than he needed and he didn't share it. He hoarded it or wasted it. But now he's running out of things to take. The balance of the bush, the land is gone. The spirit of the land is sick.

P8: Anyone with any sense would know that you can't knock the entire bush down and everything still stay the same. Of course it's going to change. I'm an old noongar who didn't get much school and learnt to read and write when I was 54, but I know that. You would think that with all the smart wadjelas (white people) in university, some of them would work that out.

CE: *Where do you get your information about climate change from?*

P8: You see it on the T.V. and in the newspapers sometimes.

P9: Yes, the news on the telly and in the papers.

CE: *Are there any other information sources you have used?*

P9: No.

P8: I can't think of any.

CE: *Do you discuss the changing climate with friends or family?*

P9: No, I haven't talked about with the family or my friends.

P8: Look at us here. You (P9) and me have never talked about it and now we are with this fella.

CE: *Do you think it could be a threat to agriculture in the future?*

P8: Of course it will be a threat. If you don't get rain then you can't grow anything.

P9: That's right, without rain nothing grows.

CE: *Do you think scientists could come up with something to make a difference?*

P9: Scientists could come up with the ideas but it's the people who have to change.

P8: If the people don't care about the land and don't understand that they are a part of it then it doesn't matter what scientists do, it won't make a difference. Look at

these farmers here. Putting poison chemicals on the grass so they can plant their crops. Then they put poison chemicals on the crops so the grubs won't eat some of the crops. All they do is put chemicals on the ground and on the food. That's why the lands' spirit is sick. The farmers keep poisoning the land. Maybe that's why people are sick, because of the poison on the food. Someday maybe it will get so bad, people will have to change.

Interview concluded.

Appendix 4: Details of Familiarisation Study interviewees

Additional background details of the participants were:

- Participant 1 was a 57 year old male farming a 720 ha property with a sheep/wool/sheep meat enterprise in the Upper Great Southern Agricultural Region. He farmed in partnership with his wife and married son and both he and his son worked off farm for six months of the year as shearers.
- Participant 2 was a 62 year old male farming a 4800 ha property with 1600 ha leased, in the Great Southern Region. Sheep meat/wool/prime lamb/grains and hay production made up the farm's enterprise mix. The farm was run as a family partnership.
- Participant 3 was a 58 year old male farming a 10,000 ha property in the North Eastern Agricultural Region. The farm enterprise consisted of grain and pulse production. The participant farmed as a sole trader.
- Participant 4 was a 33 year old female farming a 1200 ha property in a southern district of the Northern Agricultural Region. The farm enterprise was cattle production and beef feed lot. The participant farmed in partnership with her husband, who had full-time off farm employment. The participant had responsibility for the daily farming program but also had part-time employment off farm.
- Participant 5 was 42 year old male, living in Perth and employed as an agronomy consultant servicing the central, eastern and northern wheat belt regions.
- Participant 6 was a 48 year old male, living in Perth and employed as a loans manager for an agri-finance business. His area of responsibility included parts of the Avon, Central and Northern agricultural regions.
- Participant 7 was a 42 year old male, residing in Perth and employed in the livestock export industry.
- Participant 8 was a 63 year old Aboriginal male member of a Great Southern Aboriginal community. He was involved in the management of the local Aboriginal Community's commercial farm.

- Participant 9 was a 68 year old Aboriginal male member of the same Great Southern Aboriginal community. He was also involved in the management of the local community's commercial farm.

Appendix 5: Survey Document

Climate change survey

Location **Date** **ID No.**

In this first section we are trying to find out about your involvement in the rural sector.

1) Do you own, manage, or contribute to farming operations in any capacity.

1 Yes	2 No

2a) Do you own a business in a rural community? (other than farming)

1 Yes	2 No

2b) What type of business do you own? .....

3) What sort of work do you mostly do? .....

4a) Which Shire do you live in.....

4b) How long have you lived in the area

Number of years

1 less than 5	2 5 -10	3 11- 20	4 21-30	5 31- 40	6 41- 50	7 50 +

Farmers only: (Business & community respondents go to question 6a)

5a) How long have you been involved in farming?

Number of years

1 less than 5	2 5 -10	3 11- 20	4 21-30	5 31- 40	6 41- 50	7 50 +

5b) How long has your family been involved in farming?

Number of years

1 less than	2 5 -10	3 11- 20	4 21-30	5 31- 40	6 41- 50	7 50 +

5						

5c) Which of the following best describe your main business? (Read out categories)

1) Only grain	2) Beef production	3) Sheep/meat/ wool production	4) Mixed grain/stock	5) other

5d) Where is the farm located? (If farming in more than one location please list other locations/ shires)

Shire ……Other locations……

5e) How big is your property/ properties in hectares or acres?

Hct …… or Acres ……. Other locations Hct …… or Acres …….

All participants respond

6a) Are you a member of a farmer group/industry organisation?

1 Yes	2 No

6b) Are you a member of a Catchment or Landcare Group?

1 Yes	2 No

(Farmers, rural businesses and agribusinesses go to question 7a)
(Community representatives go to question 8a)

Personal perceptions of climate change

Farmers, rural businesses and agribusinesses

7a) Has your farm or business been affected by poor seasonal conditions in the past 5 – 10 years?

1 Yes	2 No

(If no please go to question 8a)

7b) Approximately how many poor seasons have you experienced in the last 10 years? (Poor seasons that have reduced business profitability)
…… (Note if different time frame is used)

7c) How much do you strongly agree or disagree with the following statements about the impact that poor seasons have had on your family and business; on the 1 to 7 scale where 1 is strongly disagree and 7 is strongly agree, or 9 if you don't know: (Show scale card)

	disagree							agree
Decreased Profitability	1	2	3	4	5	6	7	***9***
Increased Debt	1	2	3	4	5	6	7	***9***
Assets had to be sold (i.e. property, shares)	1	2	3	4	5	6	7	***9***
Increased stress	1	2	3	4	5	6	7	***9***
We managed better than other farms or businesses in the area	1	2	3	4	5	6	7	***9***

7d) Please indicate your response to poor seasons; on the 1 to 7 scale where 1 is not at all and 7 is a lot or 9 if you don't know: (Show scale card)

	Not at all	2	A little	4	Quite a bit	6	A lot
I am changing management practices	1	2	3	4	5	6	7
I am trialling different enterprises (new crops/ stock/ products)	1	2	3	4	5	6	7
I have changed enterprises	1	2	3	4	5	6	7

All participants respond

8a) Have you noticed any changes in the climate over the past 10 years; on the 1 to 7 scale where 1 is not at all and 7 is a lot or 9 if you don't know: (Show scale card)

	Not at all	2	A little	4	Quite a bit	6	A lot
Rainfall has decreased	1	2	3	4	5	6	7
Increased variability in seasons. i.e. *extended dry and warmer periods during the growing season, heavy rains in the summer*	1	2	3	4	5	6	7
More extreme weather events. i.e. *record maximum/minimum temperatures, more powerful storms*	1	2	3	4	5	6	7

8b) How strongly do you agree/disagree with the following statements about the climate over the past 10 years; on the 1 to 7 scale, where 1 is strongly disagree and 7 is strongly agree or 9 if you don't know: (Show scale card)

	disagree							agree
Poor seasons and extreme weather events are linked to climate change	1	2	3	4	5	6	7	***9***
Poor seasons and seasonal variability are just part of living and farming in rural areas	1	2	3	4	5	6	7	***9***
There have been worse seasons and droughts than the ones that have just happened	1	2	3	4	5	6	7	***9***
On average over the past 10 years, the climate has not had a big effect on the profitability of the farm or business	1	2	3	4	5	6	7	***9***

The third section is about your attitudes to climate change

All participants respond

9a) Do you strongly agree or disagree with the following statements about climate change; on the 1 to 7 scale or 9 if you don't know: (Show scale card)

	disagree							agree
Climate change is occurring	1	2	3	4	5	6	7	***9***
Climate change is occurring but will not occur in my local region	1	2	3	4	5	6	7	***9***
Climate change is a natural climatic cycle and not influenced by greenhouse emissions	1	2	3	4	5	6	7	***9***

9b) Please indicate if you strongly agree/disagree with the following statements concerning your climate change responses in the future; on the 1 to 7 scale or 9 if you don't know: **(**Show scale card)

	disagree							agree
There is no need to respond to climate change	1	2	3	4	5	6	7	***9***
I will wait and see if I need to respond to climate change	1	2	3	4	5	6	7	***9***
There is a need to respond to climate change but I am not sure what to do	1	2	3	4	5	6	7	***9***
There is a need to respond to climate change and I am responding	1	2	3	4	5	6	7	***9***

Opinions of science and science's role in climate change

Some climate scientists believe that climate change is happening faster because of greenhouse emissions

10a) Do you strongly agree or disagree with the following statements about climate change science; on the 1 to 7 scale or 9 if you don't know: **(**show scale card)

	disagree							agree
Climate change information provided by scientist is useful	1	2	3	4	5	6	7	***9***
Scientific estimates of climate change have been made without considering all factors involved	1	2	3	4	5	6	7	***9***
Scientist are exaggerating the potential effects of climate change	1	2	3	4	5	6	7	***9***
Science is divided about what has is causing climate change to happen faster	1	2	3	4	5	6	7	***9***
Climate change is the latest fashionable funding source for scientists and researchers	1	2	3	4	5	6	7	***9***

10b) How much do you strongly agree or disagree about the role science may play in providing solutions for climate change problems; on the 1 to 7 scale or 9 if you don't know: (Show scale card)

	disagree							agree
The ordinary person will contribute as much to climate change solutions as scientists	1	2	3	4	5	6	7	***9***
Humans will adapt naturally as the climate changes	1	2	3	4	5	6	7	***9***
Science cannot solve the climate change problem	1	2	3	4	5	6	7	***9***

Science should work closely with the agricultural industry & rural communities to find climate change solutions	1	2	3	4	5	6	7	***9***

The government's role in climate change solutions

All participants respond

11a) As a member of WA's agricultural community, do you strongly agree/ disagree with the following statements about the governments suggested responses to climate change; on the 1 to 7 scale or 9 if you don't know: (Show scale card)

disagree

agree

Government policy will be fair and sensitive to the needs of agriculture and rural communities	1	2	3	4	5	6	7	***9***
Government should significantly increase funding of agricultural climate change adaptation research	1	2	3	4	5	6	7	***9***
Including agriculture in the carbon trading scheme by 2015 may reduce agricultures competitiveness in world markets	1	2	3	4	5	6	7	***9***
Reducing Australia's emissions without similar action from the rest of the world will be useless in responding to climate change	1	2	3	4	5	6	7	***9***
The Government is considering responses without taking all factors into account	1	2	3	4	5	6	7	***9***
Politicians will use climate change as an election issue	1	2	3	4	5	6	7	***9***

Government policies for agriculture are sometimes based on the advice of various expert consultants. We would like to know your opinion about the Exceptional Circumstances policy.

11b) Do you strongly agree /disagree with the following statements; on the 1 to 7 scale or 9 if you don't know: (show scale card)

disagree

agree

Criteria for Exceptional Circumstances should be relevant to WA farming conditions and farmers/ rural businesses needs.	1	2	3	4	5	6	7	***9***
The Exceptional Circumstances Declaration process should be simplified	1	2	3	4	5	6	7	***9***
Drought assistance should be delivered on an individual basis	1	2	3	4	5	6	7	***9***

without an Exceptional Circumstances declaration								
Farms or businesses should run down their equity in assets before being provided with Exceptional Circumstances assistance	1	2	3	4	5	6	7	***9***
More assistance is needed to exit the industry where necessary	1	2	3	4	5	6	7	***9***

Farm & business respondents continue with question 12a.

(Non-farm/ business respondents go to question 13)

Relative importance

12a) How important are the following in the impact they may have on your business's economic sustainability; on the 1 to 7 scale where 1 is not at all important and 7 is very important or 9 if you don't know: (Show scale card)

	Not at all	2	A little	4	Quite a bit	6	very	*9*
Climate change	1	2	3	4	5	6	7	***9***
Fuel prices	1	2	3	4	5	6	7	***9***
Fertilizer prices	1	2	3	4	5	6	7	***9***
Chemical prices	1	2	3	4	5	6	7	***9***
Labour shortages	1	2	3	4	5	6	7	***9***
Interest rates	1	2	3	4	5	6	7	***9***
Environmental sustainability	1	2	3	4	5	6	7	***9***

12b) Do you think that it is important to keep yourself informed of the latest developments in your business; on the 1 -7 scale where 1is not at all important and 7 is very important or 9 if you don't know:

1 Not at all	2	3 A little	4	5 quite a	6	7 very	9

				bit			

12c) How strongly do you agree/ disagree with the following statements concerning the future of your business; on the 1 -7 scale or 9 if you don't know:

	disagree						agree	
Climate change is a major threat to the future of my business (farming/ rural business)	1	2	3	4	5	6	7	***9***
I am generally optimistic about the future of my business (farming/ rural business)	1	2	3	4	5	6	7	***9***

All participants respond

13) How strongly do you agree/ disagree with the following statements concerning the future of rural communities; on the 1 -7 or 9, don't know: (Show scale card)

	disagree						agree	
Climate change is a major threat to the future of rural communities	1	2	3	4	5	6	7	***9***
I am generally optimistic about the future of rural communities	1	2	3	4	5	6	7	***9***

14) How much do you value the views and opinions about climate change of the following people ; on the 0 to 3 scale where 0 is not at all and 3 is value highly:

Family (partner ,parents etc)	0	1	2	3
Friends	0	1	2	3
Neighbours	0	1	2	3
Community groups (school P&C, Sporting clubs)	0	1	2	3
Community Landcare and Catchments groups	0	1	2	3
Farmer & Industry Groups	0	1	2	3
Climate change scientists and researchers	0	1	2	3
Policy makers (economic experts, politicians)	0	1	2	3

Climate change information sources

15a) Do you think it is important to keep yourself informed about climate change; on the 1 -7 scale where 1is not at all important and 7 is very important or 9, don't know (Show scale card)

1 Not at all	2	3 A little	4	5 quite a bit	6	7 very	9

15b) Is climate change information easy to understand:

1 Yes	2 No

15c) What sources give you the most useful climate change information?

Rate the importance so that 3 = most important and 0 = not at all important

TV news,	0	1	2	3
Current affairs programs, documentaries	0	1	2	3
Radio (news, talkback, Country Hour)	0	1	2	3
Internet	0	1	2	3
National and State newspapers	0	1	2	3
Agri newspapers (Farmers Weekly, Countryman)	0	1	2	3
Other publications (Time, Bulletin etc)	0	1	2	3
Science publications (Journals, Reports)	0	1	2	3
Industry & grower group reports and articles	0	1	2	3
Seminars, conferences, workshops, field days	0	1	2	3
Informal discussions with family & friends	0	1	2	3
Agricultural consultants (private, government)	0	1	2	3
Federal Government's Carbon Pollution Reduction Scheme Green Paper	0	1	2	3

16) How much do you invest in long term environmental responses; on the 1 -7 scale where 1 is not at all and 7 is a lot or 9 don't know: (Show scale card)\

Only respond to what is relevant to you	Not at all	2	A little	4	Quite a bit	6	A lot	*9*
Farm (tree planting, salinity works etc)	1	2	3	4	5	6	7	***9***
Business (recycling, office greening etc)	1	2	3	4	5	6	7	***9***
Home (solar power, energy reduction practices etc)	1	2	3	4	5	6	7	***9***

17) Gender

1 Male	2 Female

18) Please indicate your age category (Please circle one category)

1 18 – 25	2 26 - 39	3 40 - 64	4 65- 79	5 80 +

Thank you for participating in this survey. In-depth interviews are also being conducted as part of the research. If you are interested in participating in these interviews please contact Chris Evans on:

Mobile 0415544909 or a/h 94730292

Please feel free to add any further comments concerning the survey or any issues not addressed in the survey that you feel are important.

Comments

.....

.....

.....

.....

.....

Research outline for participants

"Rural communities' attitudes and opinions to climate change"

In a survey of what rural people think about climate change, climate change science and the Governments proposed climate change policy as it applies to the agricultural industry and rural communities.

Being conducted by;

Chris Evans

Principal Researcher

In association with;

Dr Christine Storer and Dr Angela Wardell-Johnson

Research Supervisors

Your views will assist in ensuring that government assistance for climate change adaptation for agriculture and rural communities is directed to where it is needed most.

Are you a farmer, rural business person, agribusiness representative or do you live and work in a rural community?

Would you like to express your views and opinions about climate change by taking part in this survey?

This survey will be conducted anonymously and no personal details will be taken.

(On the reverse side of the page)

The Research Brief

Determining the opinions and attitudes of rural people to climate change, climate change science, scientists and the government's proposed climate change policy as it applies to rural communities.

The research partners are interested in the level of acceptance by farmers, rural business and community representatives of climate change and if these groups are motivated to respond to climate change.

Research partners include:

- DAFWA; Climate Adaptation Projects
- WA Farmers
- CSIRO
- Curtin University

The research will provide government and research bodies with a more detailed understanding of how WA rural communities perceive climate change. the research aims to contribute to the viability of agriculture and rural communities by ensuring that research and funding assistance is effectively prioritised.

Please feel free to use the back of this sheet to add any other comments and information you think we should know about.

If you think someone you know would like to participate in the research or get more information, please provide the following contact information:

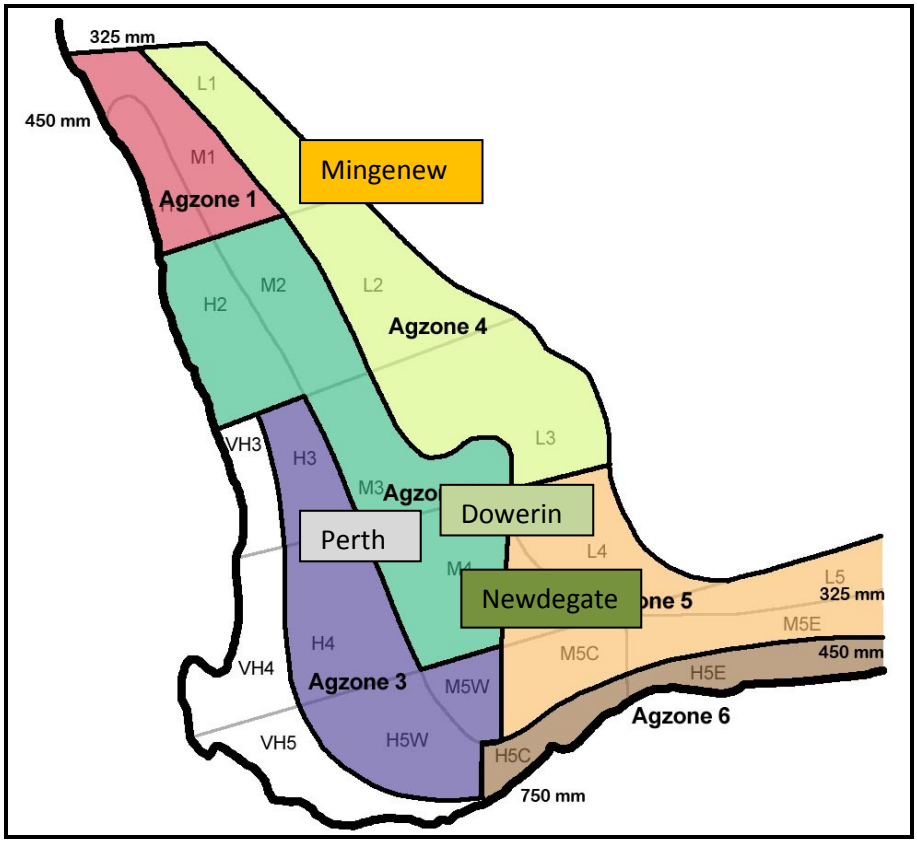
Chris Evans

Telephone: 0894730292

Mobile: 0415544909

Email: c.a.evans@postgrad.curtin.edu.au

Appendix 6: WA Agricultural Regions Rainfall Zones


325 mm
450 mm
L1
M1
Mingenew
Agzone 1
H2
M2
L2
Agzone 4
L3
VH3
H3
M3
Agzo
Dowerin
Perth
L4
M4
Newdegate
one 5
L5
325 mm
M5E
450 mm
H4
M5C
VH4
Agzone 3
M5W
H5E
Agzone 6
VH5
H5W
H5C
750 mm

Appendix 7: Australian regional rainfall deciles from 2000 to 2009

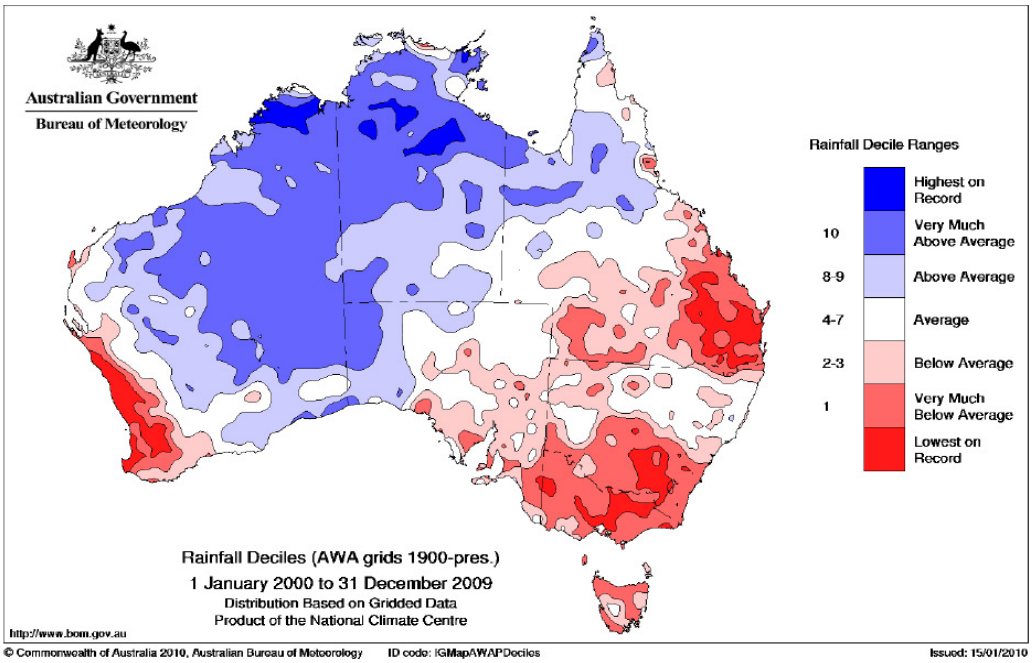


Figure 7.1 Rainfall deciles: 2000-2009
(Bureau Meteorology, 2010)

Appendix 8: Minor clusters of climate change and science values

Cluster three representing 4% of participants in the survey demonstrated significant associations with the value: 'PeopleDo' (agree: 'The ordinary person will contribute as much to climate change solutions as scientists') (Table 8.1). Participants in the cluster perceived the role of science in climate change as of little value; thought science was using climate change as a funding source but did believe science should work closely with agriculture and rural communities to find climate change solutions. There were no associations of value within the assemblage with climate change occurring and little association climate change was a natural climatic cycle and not influenced by greenhouse emissions.

Cluster two comprised 2% of the survey sample (Table 8.1). Participants in the cluster also thought science should work closely with agriculture and rural communities but unlike Cluster four did attribute some value to climate change scientists. There were also associations of values within the cluster that climate change was most likely a natural climatic cycle.

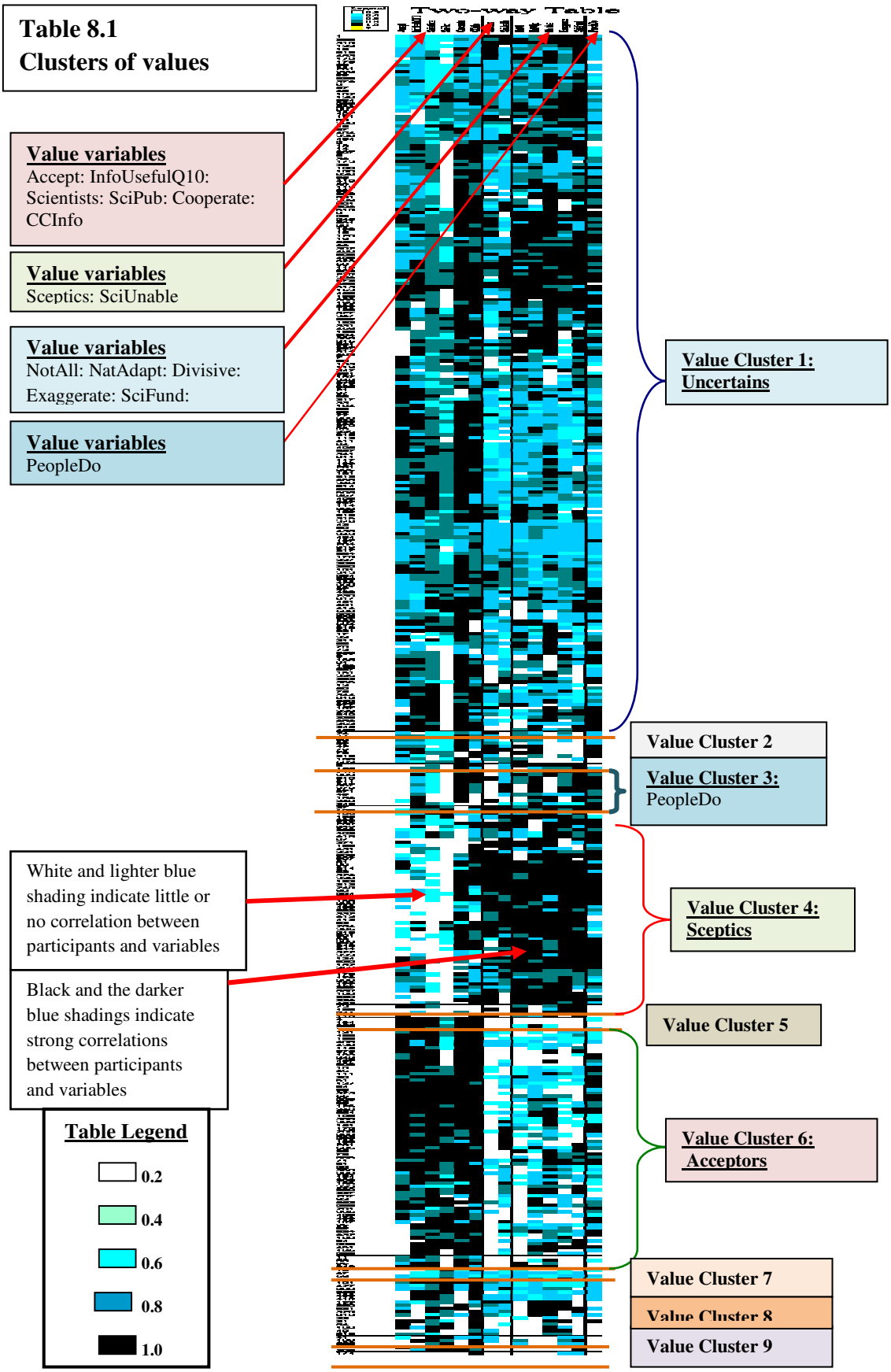
Cluster five was made up of only one percent of the survey sample (Table 8.1). There was a high association of the two values in the cluster of: 'Exaggerate' (agree: 'Scientists are exaggerating the potential effects of climate change') and 'SciFund' (agree: Climate change is the latest fashionable funding source for scientists and researchers'). Three of the participants in the assemblage did not think climate change was occurring or was a natural cycle and not influenced by greenhouse emissions.

Cluster seven also represented one percent of the survey sample (Table 8.1). There were value associations that climate change could be occurring; sciences' role in climate change was valuable and science should work closely with agriculture and rural communities to find solutions for climate change.

Cluster eight was the fourth largest cluster with 5% of participants who had taken part in the survey (Table 8.1). There was an association of the value that climate change information was easy to understand, however there were few or no associations indicated between the other value variables.

Cluster nine represented just 1% of the survey sample and shared the value that science should work closely with the agriculture and rural communities in finding solutions for climate change (Table 8.1). There were little or no associations shown between other values and participants.

Table 8.1
Clusters of values



Bray Curtis,
UPGMA Beta, -0.05: (n=411)

Appendix 9: Non significant demographic clusters

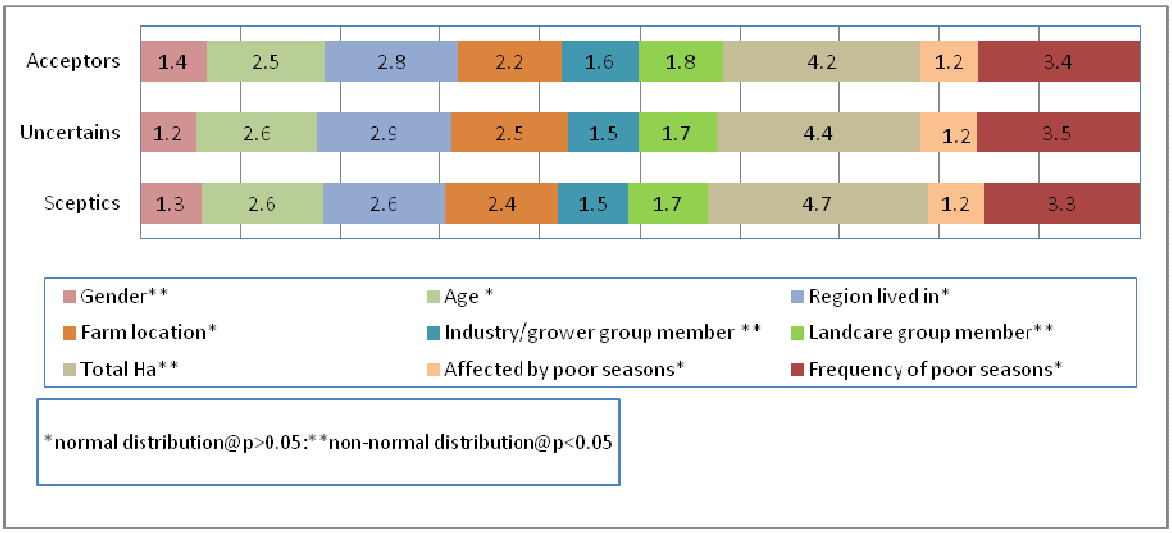


Figure 9.1 Non significant demographic characteristics of clusters

n='Acceptors' 38-74/'Uncertains'131-206/'Sceptics'49-62
Scales: Age;1=18-25yrs/2=26-39yrs/3=40-64yrs/4=65-79yrs
Gender;1=male/2=female
Region lived-farm location;1=Southwest/2=Avon/3=South coast/4=NAR/5=Perth
Industry-Landcare member;1=yes/2=no
Total Ha;1=1-44/2=45-500/3=501-1000/4=1001-2000/5=2001-4000
Affected by poor seasons;1=yes/2=no
Frequency of poor seasons;1=1yr-9=9yrs

Appendix 10: Long term environmental investment on farms

Responses to: 'How much do you invest in long term environmental responses on the farm?' indicated most farmers in all the clusters had initiated a relatively high level of investment (Figure 10.1):

- 44% of 'Acceptors' invested 'a lot'/'quite a lot'
- 44% of 'Uncertains' invested 'a lot'/'quite a lot'
- 45% of 'Sceptics' invested 'a lot'/'quite a lot'

There were different levels of investment when it came to long term environmental investments in the business and home (Figure 10.1) with 'Acceptors' investing more than 'Uncertains' and 'Sceptics':

- 'Long term environmental investment in businesses'
  - 30% of 'Acceptors' invested 'a lot'/'quite a lot'
  - 19% of 'Uncertains' invested 'a lot'/'quite a lot'
  - 12% of 'Sceptics' invested 'a lot'/'quite a lot'

- 'Long term environmental investment in homes'
  - 34% of 'Acceptors' invested 'a lot'/'quite a lot'
  - 28% of 'Uncertains' invested 'a lot'/'quite a lot'
  - 16% of 'Sceptics' invested 'a lot'/'quite a lot'

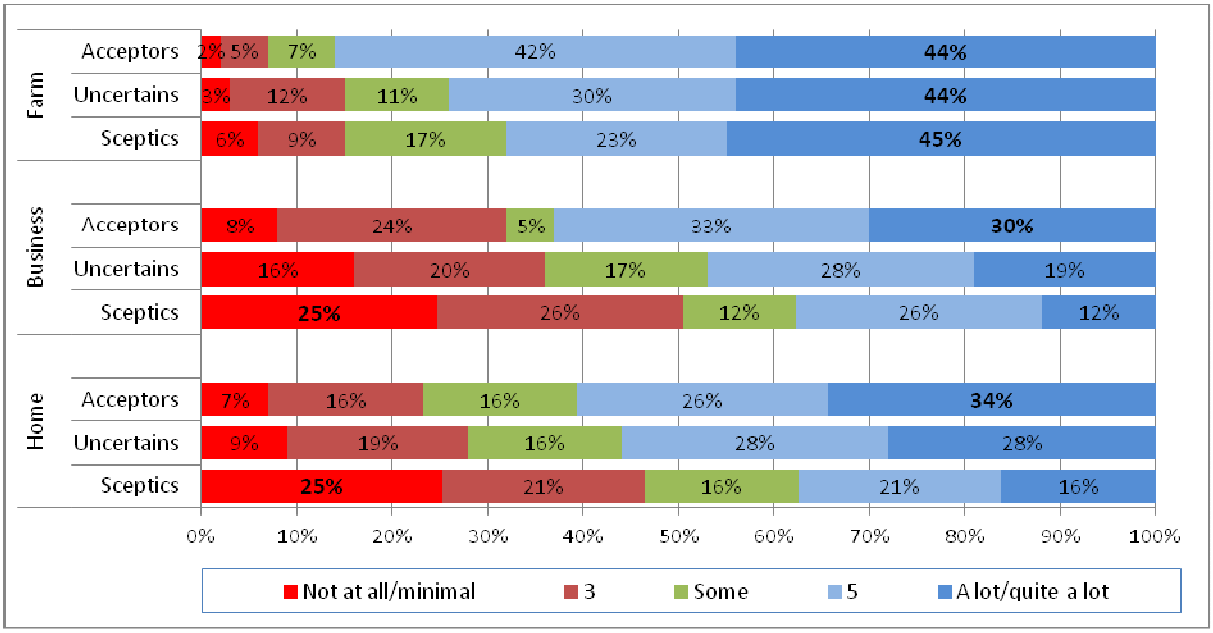


Figure 10.1 Clusters' environmental investment in farms, businesses and homes

n='Acceptors' 43-73/'Uncertains' 134-196/'Sceptics' 47-46

Appendix 11: Issues of trust and credibility in government

- Government policy will be fair and sensitive to the needs of agriculture and rural communities'
  - ➢ 34% of 'Acceptors' strongly disagreed or disagreed
  - ➢ 40% of 'Uncertains' strongly disagreed or disagreed
  - ➢ 75% of 'Sceptics' strongly disagreed or disagreed

- 'Government is considering responses without taking all factors into account'
  - ➢ 40% of 'Acceptors' strongly agreed or agreed
  - ➢ 55% of 'Uncertains' strongly agreed or agreed
  - ➢ 80% of 'Sceptics' strongly agreed or agreed

However, most participants in each cluster were quite certain climate change would be used as an election issue:

- 'Politicians will use climate change as an election issue'
  - ➢ 82% of 'Acceptors' strongly agreed or agreed
  - ➢ 83% of 'Uncertains' strongly agreed or agreed
  - ➢ 82% of 'Sceptics' strongly agreed or agreed

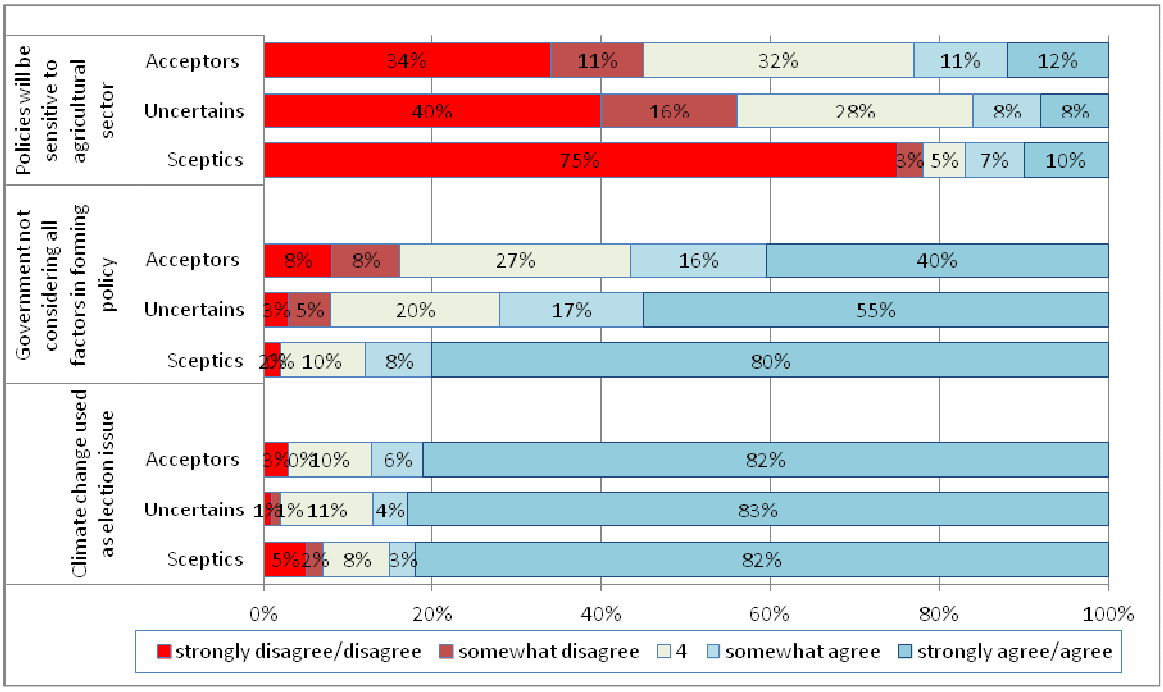


Figure 11.1 Credibility and trust of government

'Acceptors' n=72-73; 'Uncertains' n=203-204; 'Sceptics' n=60

Questions about whether national policy proposals should include agriculture in some form of carbon emissions trading scheme and whether Australia should undertake emissions reduction initiatives regardless of the international community's responses elicited different degrees of concern and uncertainty within the clusters? (Figure 11.2).

- 'Including agriculture in the carbon trading scheme by 2015 may reduce agriculture's competiveness in world markets'
    - 25% of 'Acceptors' strongly agreed or agreed; 44% were unsure
    - 41% of 'Uncertains' strongly agreed or agreed; 36% were unsure
    - 57% of 'Sceptics' strongly agreed or agreed

- 'Reducing Australia's emissions without similar action from the rest of the world will be useless in responding to climate change'
    - 45% of 'Acceptors' strongly agreed or agreed
    - 65% of 'Uncertains' strongly agreed or agreed
    - 82% of 'Sceptics' strongly agreed or agreed

There was a relatively high level of unanimity between the clusters to the question:

- 'Government should significantly increase funding of agricultural climate change adaptation research'
    - 66% of 'Acceptors' strongly agreed or agreed
    - 59% of 'Uncertains' strongly agreed or agreed
    - 55% of 'Sceptics' strongly agreed or agreed

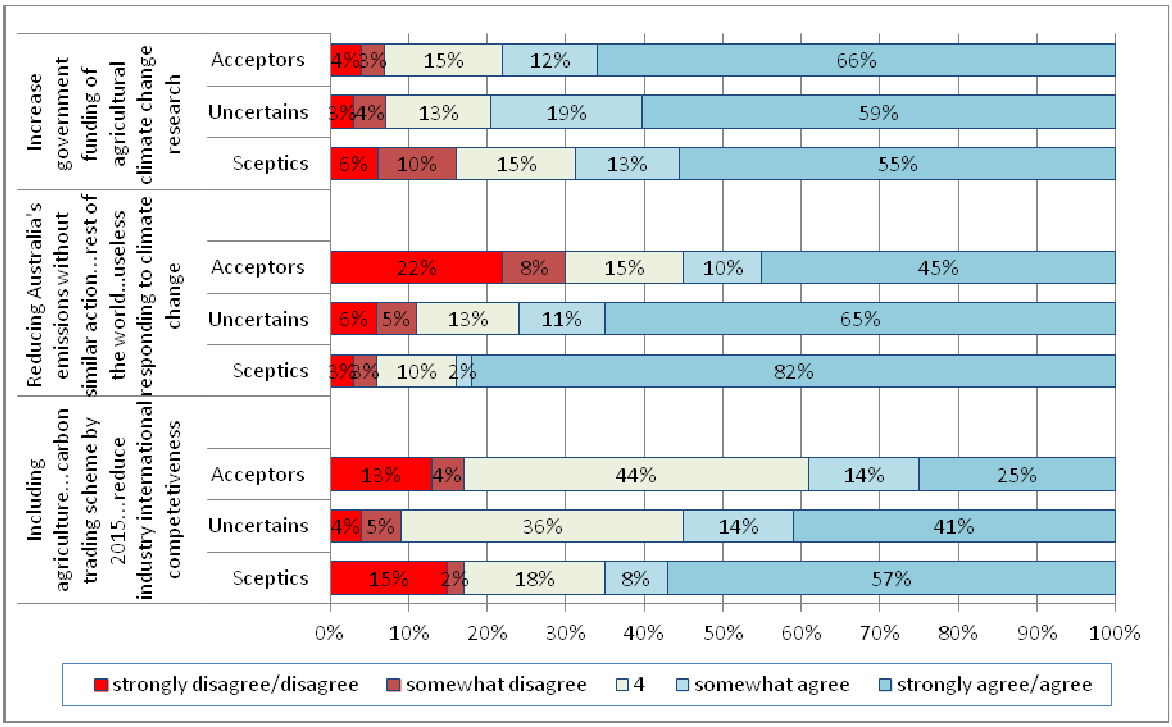


Figure 11.2 Concern about approaches to climate change policy

'Acceptors' n=72-73; 'Uncertains' n=203-204; 'Sceptics' n=60

Appendix 12: Exceptional Circumstances Report

At the time the research was being conducted, a review of national drought policy had been commissioned by the Federal Government. The review was to evaluate the future of drought relief and the then current form of drought relief, Exceptional Circumstances (EC) assistance (DAFF, 2012).

The aim of the research in including farm/business participant's responses to EC assistance was to examine WA farmer's responses to what was at the time of the survey, current drought assistance policy. This was done to evaluate how they perceived existing policy responses to 'exceptional' (extreme) climatic conditions and to see if there were differences between what famers believed should occur in the event drought assistance was needed and the short comings they perceived in policy approaches to administering drought assistance.

The intention of EC was to provide Australian farmers affected by drought with financial assistance (Department of Agriculture Fisheries and Forestry, 2012). One key element of EC assistance was eligibility of farmers for assistance through their shires being officially declared as drought affected. The declaration process relied on a series of criteria which included a major decrease in rainfall leading to a severe decrease in production and farm income (Department of Agriculture Fisheries and Forestry, 2012). However the definition of 'exceptional' drought was acknowledged as being contentious and varied from state to state (Burdon, 1995). The difficulties' in defining exceptional drought and the variation of definition from state to state led to some dissatisfaction among farmers. Participants were asked to respond to statements in regard to EC. The statements were derived from the terms of reference given to the Productivity Commission's inquiry into government drought support (Productivity Commission, 2008; McMillan, CEO of the Western Australian Farmers Federation (WA Farmers) pers com, 2008)

- Relevancy of EC criteria to WA farming conditions was questioned by participants in each cluster (Figure 12.1): 'Criteria for EC should be relevant to WA farming conditions and farmers/rural businesses needs'
    - 56% of 'Acceptors' strongly agreed/agreed

- 60% of ‘Uncertains’ strongly agreed/agreed
- 69% of ‘Sceptics’ strongly agreed/agreed

- ‘EC declaration process should be simplified’;
  - 55% of ‘Acceptors’ strongly agreed/agreed
  - 55% of ‘Uncertains’ strongly agreed/agreed
  - 67% of ‘Sceptics’ strongly agreed/agreed

- ‘Drought assistance should be delivered on an individual basis without an EC declaration for a region’;
  - 43% of ‘Acceptors’ strongly agreed/agreed
  - 42% of ‘Uncertains’ strongly agreed/agreed
  - 71% of ‘Sceptics’ strongly agreed/agreed

- ‘Farms and business should run down their equity in assets before being provided with EC assistance’;
  - 42% of ‘Acceptors’ strongly disagreed/disagreed
  - 43% of ‘Uncertains’ strongly disagreed/disagreed
  - 44% of ‘Sceptics’ strongly disagreed/disagreed

- ‘More assistance is needed to exit the industry where necessary’
  - 45% of ‘Acceptors’ strongly agreed/agreed
  - 35% of ‘Uncertains’ strongly agreed/agreed
  - 46% of ‘Sceptics’ strongly agreed/agreed

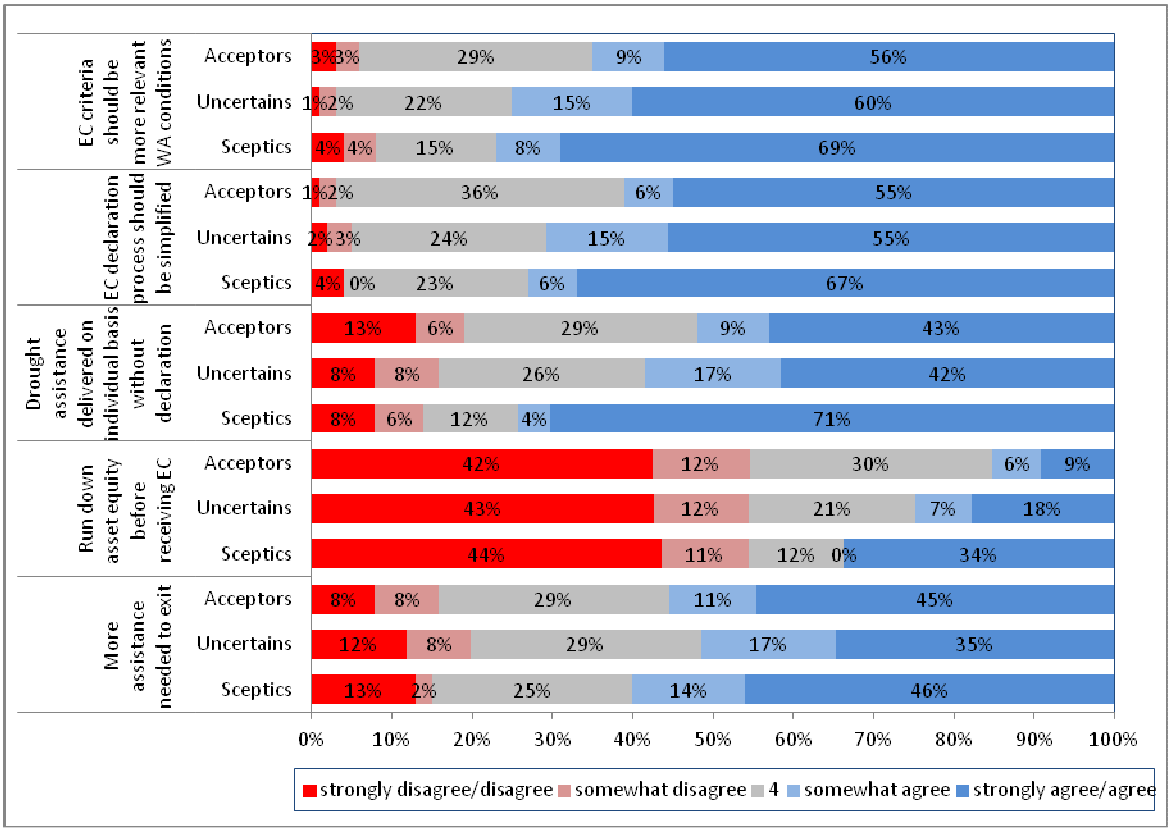


Figure 12.1 Perceptions of EC assistance

'Acceptors' n=65-66; 'Uncertains' n=180-183; 'Sceptics' n=52

There was relatively strong support from farm/business participants for the idea that EC criteria should be relevant to WA farming conditions and business needs (mean 5.5, SD 1.4) and EC declaration processes be simplified (mean 5.4, SD 1.5) (Table 12.2). Farm/business participants also showed support for drought assistance being delivered on an individual as needed basis rather than waiting for a shire to be drought declared before farmers could access assistance (mean 5.0, SD 1.7). However there was less acceptance among farm/business participants for running down a business's equity in assets before the business was eligible for EC assistance (mean 3.2, SD 1.9) whereas there was reasonable support among farm/business participants for increased financial assistance to leave the industry (mean 4.8, SD 1.7) (Table 12.2).

Table 12.2 Opinions of governments' drought assistance criteria

Statement	Freq.	Mean	S.D
Criteria for EC should be relevant to WA farming conditions and farmers/rural businesses needs	364	5.5	1.4
The EC declaration process should be simplified	363	5.4	1.5
Drought assistance should delivered on an individual basis without an EC declaration for a region	361	5.0	1.7
More assistance is needed to exit the industry where necessary	363	4.8	1.7
Farms/businesses should run down their equity in assets before being provided with EC assistance	361	3.2	1.9

On a scale of 1 – 7, where 1 = strongly disagree and 7 = strongly agree

Farm/business participants generally thought as far as WA farming and rural business conditions were concerned there were issues with EC criteria. To understand the source of the issues farmers and rural businesses had with EC criteria, the research examined several additional variables which may have had an influence on farm/business participant's attitudes. The variables included the number of poor seasons farmers had experienced in the previous ten years with age and experience of farm/business participants in farming/rural business and the length of time farm/business participants' had lived in area.

12.1 Influence of being affected by poor seasons on attitudes to EC criteria

Although gender was not a factor in differences between farm/business participant's attitudes to EC assistance criteria, being affected by poor seasons was. Results of an independent sample T-Test indicated there was a significant difference in responses between farm/business participant's who had been affected by poor seasons in the previous ten years (mean 5.8) and those who had not (mean 5.1) as to the relevancy of EC criteria to WA conditions (Figure 12.3).

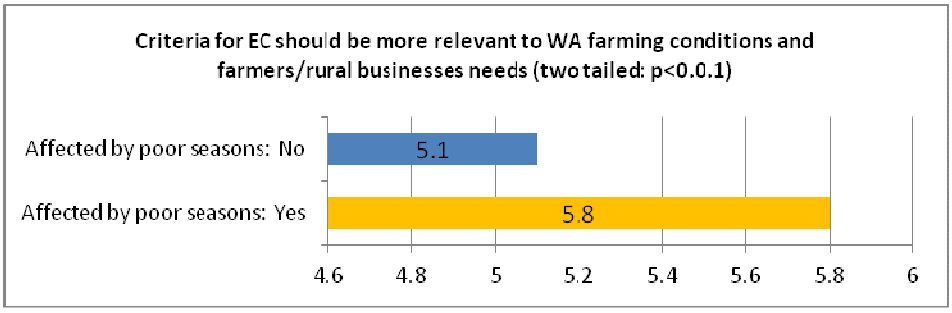


Figure 12.3 Farm/businesses affected by poor seasons: Differences in perceptions of EC criteria

n=309: Affected by poor seasons; Yes: n=219: Affected by poor seasons; No: n=55

However results showed age of participants had more bearing on their attitudes to EC assistance criteria than being affected by poor seasons or not. Analysis had shown association of age with attitudes to EC criteria was not influenced by the number of poor seasons in the previous ten years the various age groups of participants had experienced.

12.2 Age influence on attitudes to EC criteria

ANOVA results indicated significant differences between age groups as to whether EC assistance criteria should be relevant to WA conditions ($p<0.01$) and the EC declaration process should be simplified ($p<0.01$). In addition there were differences between farm/business age groups as to drought assistance being delivered on a individual as needed basis without a EC declaration for a shire ($p<0.01$) (Figure 12.4).

Response to the statement: 'Criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' indicated strong support (mean 6.0) from the oldest farm/business participants (65-79 years) and the forty to sixty four year age group (mean 5.7). The youngest farm/business participants (18-25 years) in the survey were somewhat less certain EC criteria should be relevant to WA conditions (mean 4.9) along with the twenty four to thirty nine age group (mean 5.1) (Figure 12.4).

Likewise responses to the statement: 'The Exceptional Circumstances Declaration process should be simplified' again demonstrated strong agreement from the sixty

five to seventy nine years age group and forty to sixty four year age group (mean 5.7). Eighteen to twenty five year old farm/business participants were less sure if 'Exceptional Circumstances Declaration processes should be simplified' (mean 4.6) along with twenty six to thirty nine year old farm/business participants (mean 4.8) (Figure 12.4).

The question of 'Drought assistance being delivered on an individual basis without an Exceptional Circumstances declaration for a region' also drew strong support in responses from the sixty five to seventy nine year age group (mean 5.6) and forty to sixty four year age group (mean 5.3). Eighteen to twenty five year old farm/business participants thought drought assistance should be delivered on an individual needs basis without the requirement for an EC declaration (mean 4.9). In comparison twenty six to thirty nine year old farm/business participants were much less convinced drought assistance should be delivered on an individual basis without an Exceptional Circumstances declaration for a region (mean 4.3) (Figure 12.4).

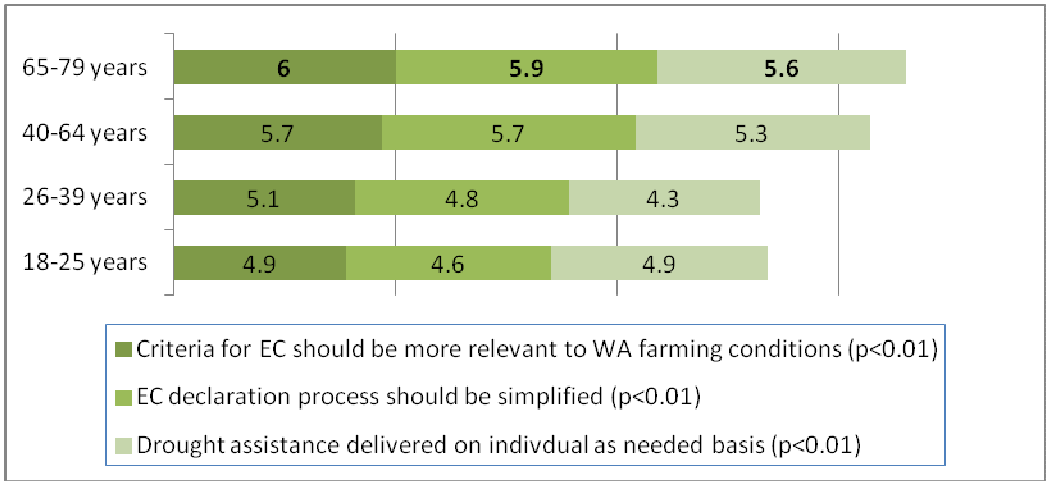


Figure 12.4 Age: Differences in perceptions of EC criteria
n=358-360

Even though there were associations between the age of participants and issues with EC criteria, previous analysis of participant's attitudes to sciences' role in climate change (Chapter 7) and attitudes to climate change and climate change threat (Chapter 6) had identified experience as a key factor underpinning attitudes. As a consequence of these earlier results, the research compared responses to EC criteria with the time participants' had lived in area and time involved in farming.

12.3 Farming experience influence on attitudes to EC criteria

As with age, experience in farming had a significant bearing on participant's attitudes to EC and how it should be applied in WA agricultural regions. Again there were statistically significant differences between participants in their attitudes to EC criteria based on the time they had been involved in farming. ANOVA results illustrated the extent farming experience contributed to differences between groups of participants in responses to the statements; 'Criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' ($p<0.01$): 'The Exceptional Circumstances Declaration process should be simplified' ($p<0.01$): 'Drought assistance should be delivered on an individual basis without an Exceptional Circumstances declaration for a region' ($p<0.01$) (Figure 12.5).

The statement: 'Criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' drew strong support from participants who been involved in farming the longest (50+ years) (mean 6.1) and those who had been farming for forty one to fifty years (mean 6.3). Farmers with less than five years experience were the least certain 'Criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' (mean 4.9) (Figure 12.5). There was also strong agreement with the statement: 'The Exceptional Circumstances Declaration process should be simplified' in the responses of farmers with more than fifty years in farming (mean 6.2) and forty one to fifty years in farming (mean 6.1). Farmers with less than five years experience were not sure if the 'Exceptional Circumstances Declaration process should be simplified' (mean 4) while farmers with five to ten years experience were only somewhat sure the EC declaration process should be simplified (mean 5.1) (Figure 12.5).

In the same way the question of 'Drought assistance being delivered on an individual basis without an Exceptional Circumstances declaration for a region' drew similar responses from the different groups of experience. Responses of farmers with forty one to fifty years experience in farm indicated agreement (mean 5.6) that drought

assistance should be delivered on an individual basis without a declaration along with farmers with more than fifty years experience (mean 5.7) (Figure 12.5). Farmers with five to ten years in farming were unsure (mean 4.2) if drought assistance should be delivered on an individual basis without a declaration for a region while farmers with less than five years in farming were only marginally less unsure if drought assistance should be delivered on an individual basis (mean 4.6) (Figure 12.5).

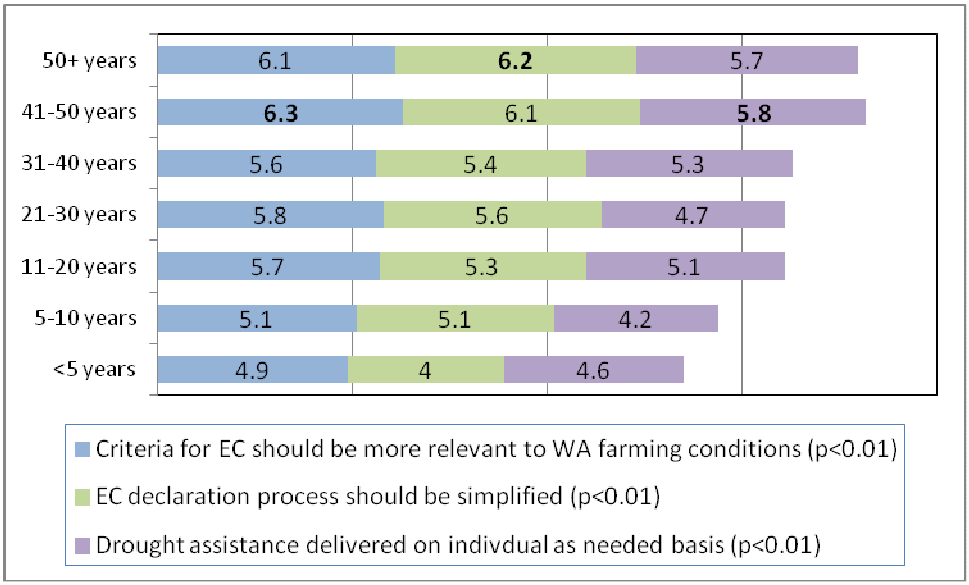


Figure 12.5 Experience in farming: Differences in perceptions of EC criteria
n=358-360

Experience, based on the time participants had been involved in farming was again shown to be a contributory element in participant's attitudes and perceptions. In the case of EC criteria it was farm/business participants with longest involvement in farming/rural business who perceived a need for EC criteria to be made more relevant to WA farming/rural business conditions. The more experienced group of participants were also the ones who believed the EC declaration process should be simplified and EC assistance should be delivered to individual farmers without the requirement of a shire to be drought declared. The results indicated the more

experience and knowledge farmers and rural business participants acquired the greater the distance between what they believed was required to meet a need and what policy makers perceived was needed. The results again provided evidence of "epistemological" distances (Garvin, 2001) between farmers and policy maker's analytical paradigms.

One further association between experience/knowledge and farm/business attitudes to EC criteria was family history in farming. Results of Analysis of Variance depict an almost perfect linear association of family history in farming with responses to: 'Drought assistance should be delivered on an individual basis without an Exceptional Circumstances Declaration for a region'. There were significant differences ($p<0.05$) in responses to the statement between participants who had family involvement for less than five years (mean 3.1) compared to participants with forty one to fifty years family involvement in farming (mean 5.5)

Farmers with less than five years family history in farming tended to disagree drought assistance should be delivered on an individual basis without an Exceptional Circumstances Declaration for a region' (mean 3.1) while farmers with five to ten years family involvement in farming were somewhat unsure (mean 3.8). The farmers with eleven to twenty years and twenty one to thirty years family history in farming were relatively certain drought assistance should be delivered on an individual basis without the need for a shire declaration (mean 4.6). Those farmers with thirty one to forty years family history in farming indicated somewhat more certainty drought assistance should be delivered on an individual basis without a shire declaration (mean 4.8). However it was farmers with forty to fifty years agreed (mean 5.5) along with farmers with more than fifty years family history in farming who showed the most support for EC assistance to be delivered on an individual as needed basis without a shire declaration (mean 5.3) (Figure 12.6).

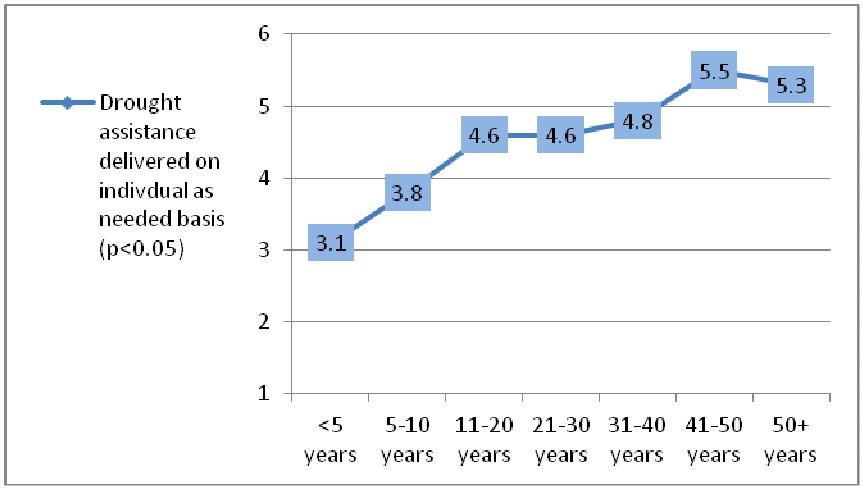


Figure 12.6 Family history in farming: Differences in perceptions of EC criteria
n=214
Y axis on a scale of 1- 7 where 1=strongly disagree and 7= strongly agree

12.4 Time lived in an area: Influence on attitudes to EC criteria

Statistically significant differences were shown between participants responses based on the time they had lived in area in their attitudes to EC criteria. Analysis of variance revealed significant differences were present between groups of responses to the statements; 'Criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' ($p<0.01$): 'Exceptional Circumstances Declaration process should be simplified' ($p<0.01$): 'Drought assistance should be delivered on an individual basis without an Exceptional Circumstances declaration for a region' ($p<0.05$) (Figure 12.7).

Participants who had lived in area for more than fifty years generally agreed 'criteria for Exceptional Circumstances assistance should be relevant to WA farming conditions and farmers/rural businesses needs' (mean 6.2) compared to responses of participants who had lived in an area for less than five years who were uncertain (mean 4.1) (Figure 12.7).

Responses to the statement: 'Exceptional Circumstances Declaration process should be simplified' also showed strong support among participants who had lived in area for more than fifty years (mean 6.1) compared to those who had lived in area for less than five years (mean 4.8) (Figure 12.7).

Differences between groups were not as pronounced in response to: 'Drought assistance should be delivered on an individual basis without an Exceptional Circumstances declaration for a region'. Participants with more than fifty years experience of living in area indicated more certainty (mean 5.8) that drought assistance should be delivered on an individual basis without a shire declaration compared to participants with less than five years experience of living in area who were less certain (mean 4.7) (Figure 12.7).

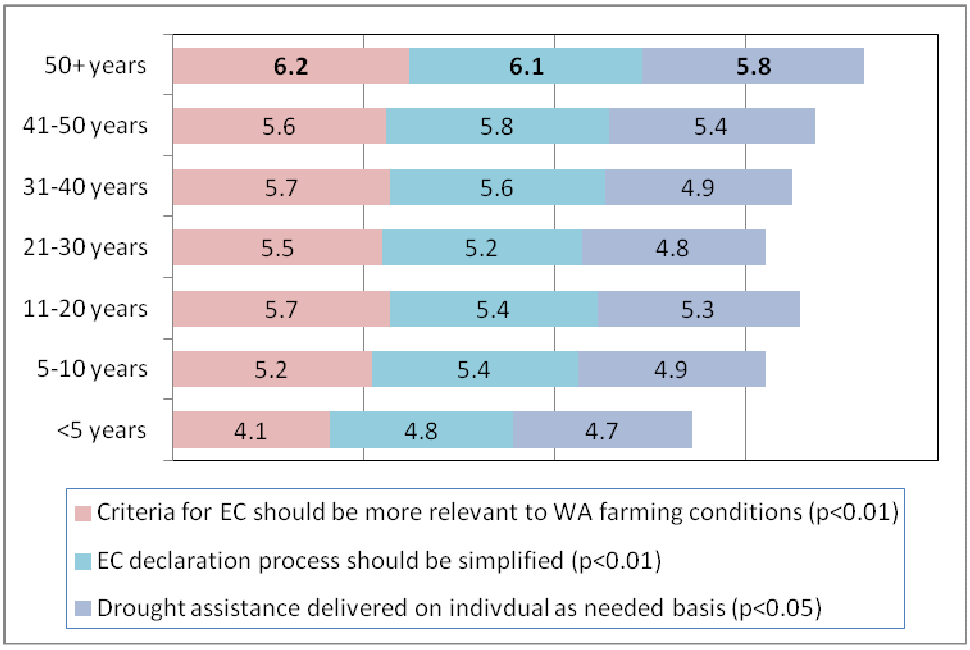


Figure 12.7 Time lived in area: Differences in perceptions of EC criteria
N=356-359

12.5 Discussion of the influence of experience to attitudes of EC criteria

The results indicated interdependent relationships between age and experience and participant's attitudes to criteria applied to EC assistance. That generally being, the older, more experienced and longer a participant had lived in an area the more inclined they were to feel EC assistance criteria was not relevant to their circumstances or needed to be adjusted to meet their circumstances. These interdependent relationships of age and experience with attitudes to EC criteria point to the presence of "epistemological" distances in analytical paradigms (Garvin, 2001) of what criteria farmers believed was necessary for drought assistance and what criteria policy makers thought appropriate. The differences in the analytical

paradigms of farmer and policy maker lay in the environment and approach in which each party constructs the knowledge and based on the knowledge construct, evaluates the need or the response to the need. Farmers evaluations' tend to be based on their experience and knowledge derived within a local socio-cultural context framework of need or risk (Holloway, 1999) and as such the evaluations are more likely to be experiential and intuitive in nature (Garvin, 2001; Margolis, 1996). On the other hand policy makers, the 'experts' among others, are more likely to rely on the 'hard' knowledge evidence of definitive probabilities (Garvin, 2001; Kempton, 1991).

The differences in criteria between what farmers and policy makers perceived as necessary raised the possibility that concerns some participants had with the relevance of EC criteria to their own or other farmers circumstances may have been reflected in their attitudes to government's role in climate change. That is, what they had experienced of government administrative responses to drought had influenced their perceptions of what could be the effects and outcomes of governments future responses to the much more complex issues associated with climate change. Unfortunately the research did not include the questions needed to explore these areas more comprehensively in order to develop conclusive evidence of a direct link between participant's attitudes to the relevance of EC criteria with their attitudes to government's role in climate change and ultimately their attitudes to climate change. However these linkages between farmer's experiences with policy responses presents as a future topic for research, given the potential for ongoing and future tensions between farmers and policy as to what needs, problems and issues arising from climate change policy should address.

Despite these shortcomings the research was still able to explore if there were interdependent relationships between participants responses to their attitudes government's role in climate change by undertaking a Factor Analysis of the responses to government and EC questions in the survey.

Appendix 13: Results of total sample responses to information/knowledge sources

The following results are from analysis of the whole survey sample (n 411).

There was a general acquiescence that it was important to be informed about climate change (Figure 13.1). Over a third (38%) of participants believed it was very important and a quarter thought it important (23%), while 19% felt it quite a bit important to remain informed about climate change.

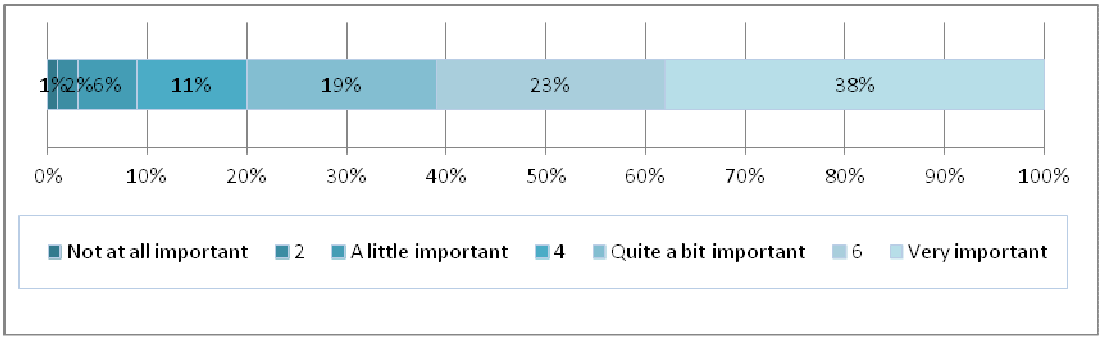


Figure 13.1 Importance of being informed about climate change
N=411

Participants were then asked to indicate the value they ascribed to the climate change views of a prescribed list of groups representing: close personal social structures (family, friends and neighbours); community social structures (community, Landcare, farmer and industry groups); community social structures; and macro social structures of science and government.

Participants generally rated the views of close personal structures quite valuable (Figure 13.2).

- Family/friends/neighbours' climate change views:
  - 78% respected family views (37% highly valued/41% valued)
  - 68% respected friends' views (25% highly valued/43% valued)
  - 57% respected neighbours' views (19% highly valued/38% valued)

Equally the climate change views of Landcare and farmer/industry groups were valued with slightly fewer participants valuing the views of community groups (Figure 13.2).

- Community/Landcare/Farmer/industry groups:
  - 74% respected Industry/grower groups' views (35% highly valued/40% valued)
  - 67% respected Landcare groups' views (30% highly valued/37% valued)
  - 45% respected Community groups' views (14% highly valued/31% valued)

Although many participants valued scientists' climate change views, far fewer valued policy makers' views (economic experts/politicians) (Figure 13.2):

- Scientists/Policy makers:
  - 69% respected scientists' views (33% highly valued/36% valued)
  - 30% respected policy makers' views (5% highly valued/25% valued)

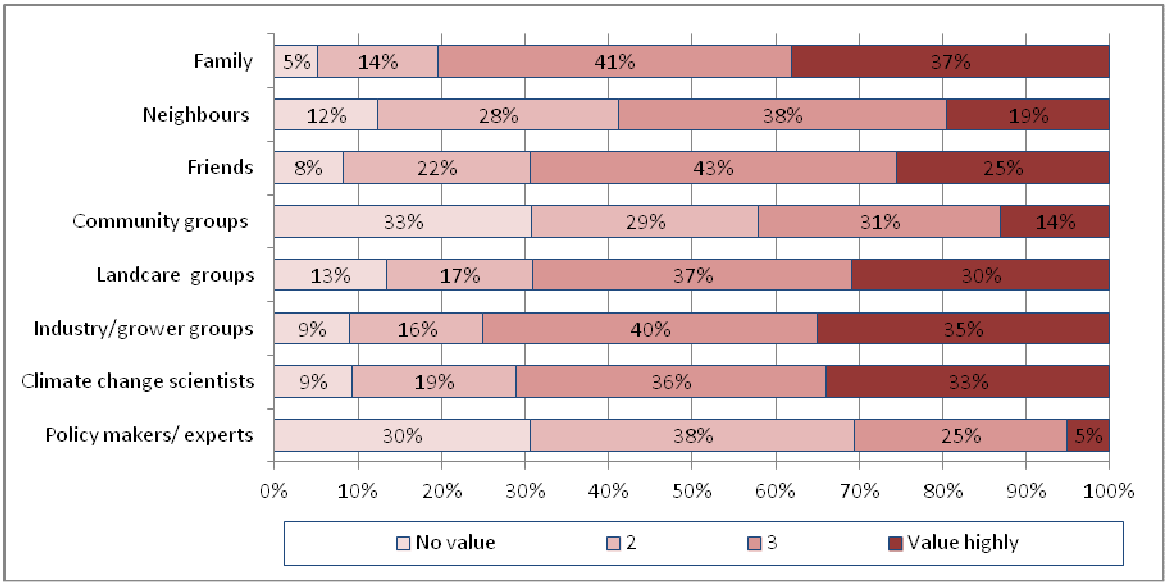


Figure 13.2 Valued climate change views of different groups and organisations
n= 395-400 *n=255farmers

Generally, participants were more likely to respect the climate change views and opinions of family followed by: scientists; farmer/industry groups; friends; and Landcare groups (Figure 13.3). Neighbours and community groups' opinions were less well regarded with little value attached to the views of policy makers.

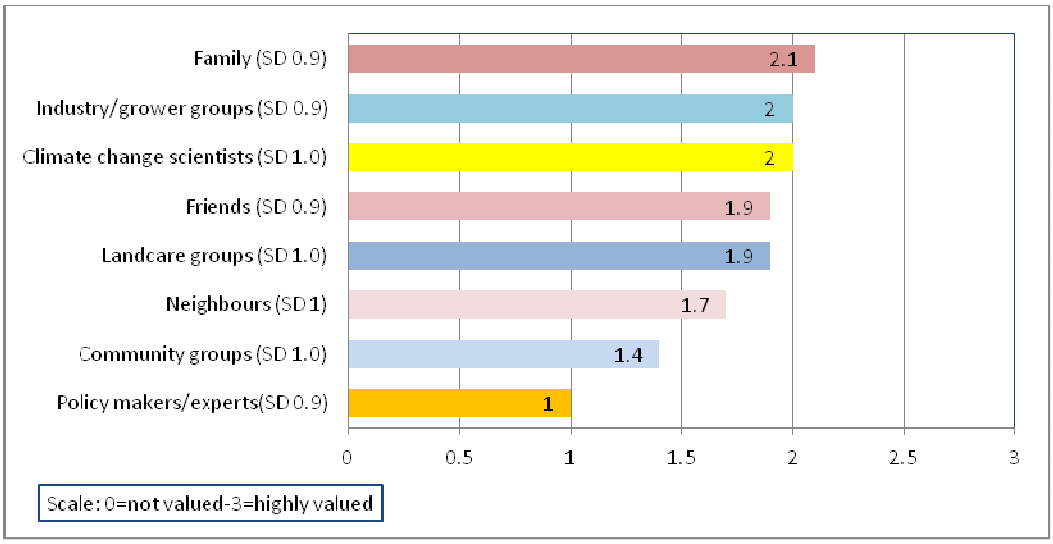


Figure 13.3 Ranking of social structures' climate change views
n=255-400

13.1 Climate change information sources

The research then looked at the information sources participants thought were useful in providing climate change information. Some research suggested that media coverage of climate change has added little to the public's knowledge (Krosnick et al., 2000). In turn, Potter and Oster (2008) questioned how the media could ever represent climate change as a matter of public concern. American research has also suggested the media was trusted to deliver an unbiased reporting of climate change (Fortner et al., 2000) although Maibach et al. (2009) found 53% of Americans did not trust or were sceptical of the media's climate change reportage. Milne et al. (2008) found in their study of Australian farmers that most sourced climate change information from daily newspapers and regional/rural print and electronic media sources. Other information sources nominated by farmers in the study included science, government publications and industry/grower groups' publications and extension agents. The approach of this research was to evaluate what information sources participants thought were important in providing what they perceived to be 'useful' climate change information.

The information sources participants assessed for importance in providing useful climate change information represented popular and regional/rural media, agricultural information contexts in addition to science and policy as identified in the earlier in-depth interviews in the Familiarisation research process (Figure 13.4).

Participants tended to rate most media sources as important, although national/state newspapers and TV news were considered less important.

- 77% favourably rated Current Affairs/documentary programs (33% very important/44% important
- 75% favourably rated Agri-newspapers (29% very important/46% important)
- 65% favourably rated Regional/rural radio (27% very important/38% important)
- 57% favourably rated National/ state newspapers (15% very important/42% important)
- 50% favourably rated TV news (16% very important/34% important)

Industry/grower groups and seminars/workshops/field-days were thought to be important in providing climate change information by the majority of participants, while family and friends and agricultural consultants were seen to be less important.

- 69% favourably rated industry/grower group publications (25% very important/44% important)
- 64% favourably rated seminars/workshops/field-days (24% very important/40% important)
- 57% favourably rated family and friends (18% very important/39% important)
- 51% favourably rated Agricultural consultants: (14% very important/37% important)

Scientific information sources on the internet were regarded as being important by half of the participants but fewer participants felt 'other' publications such as *Time* magazine and policy publications were important (Garnaut, 2008; Federal Governments Carbon Pollution Reduction Scheme Green Paper).

- 51% favourably rated internet sources (19% very important/32% important)
- 50% favourably rated science publications (20% very important/30% important)
- 34% favourably rated 'other' publications (8% very important/26% important)
- 25% favourably rated policy publications (3% very important/22% important)

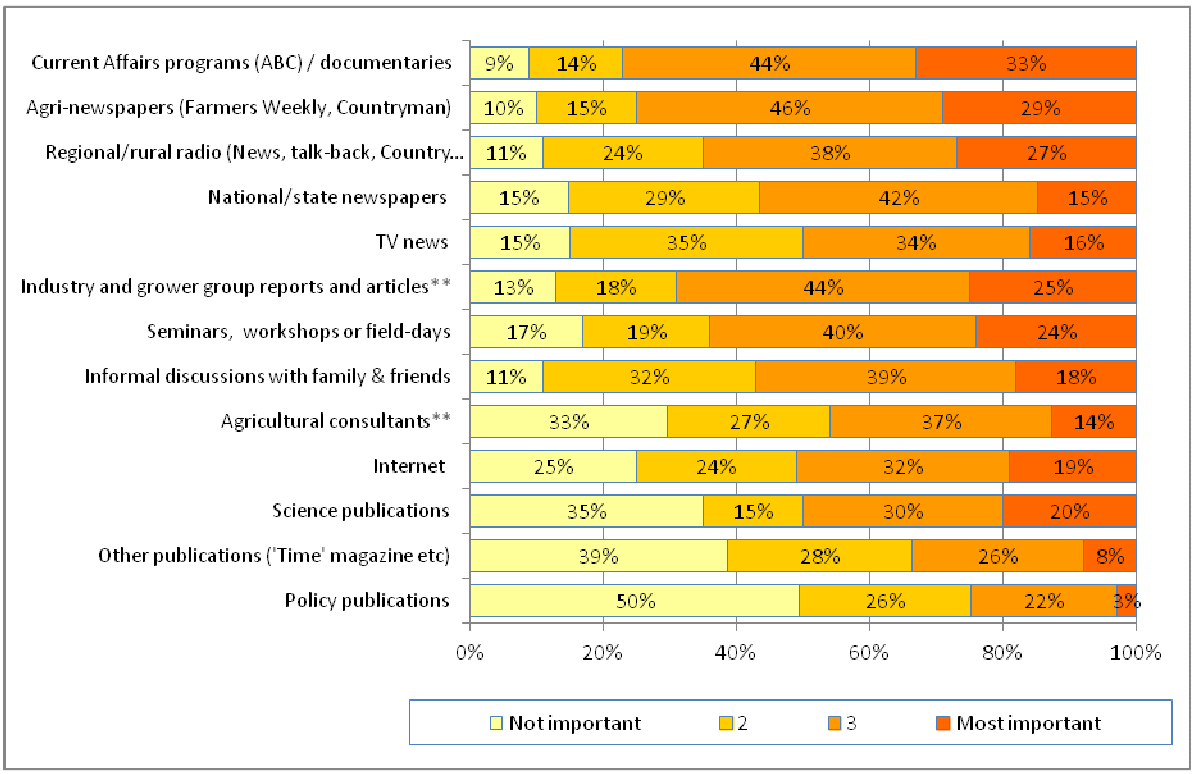


Figure 13.4 Useful climate change information sources

n=383-395**n=238-255farmers

Overall, current affairs programs; agri-newspapers, regional radio programs and industry and grower groups' reports and articles were viewed as the most important for useful climate change information (Figure 13.5). Seminars, conferences, workshops and field days, discussions with family and friends, TV news and national and state newspapers were identified as slightly less important information sources. Farming participants thought that agricultural consultants were a less useful climate change information source, while science publications and the internet were ranked as somewhat useful. Other publications (e.g. *Time* magazine) and policy publications were seen to be of little importance in providing useful climate change information.

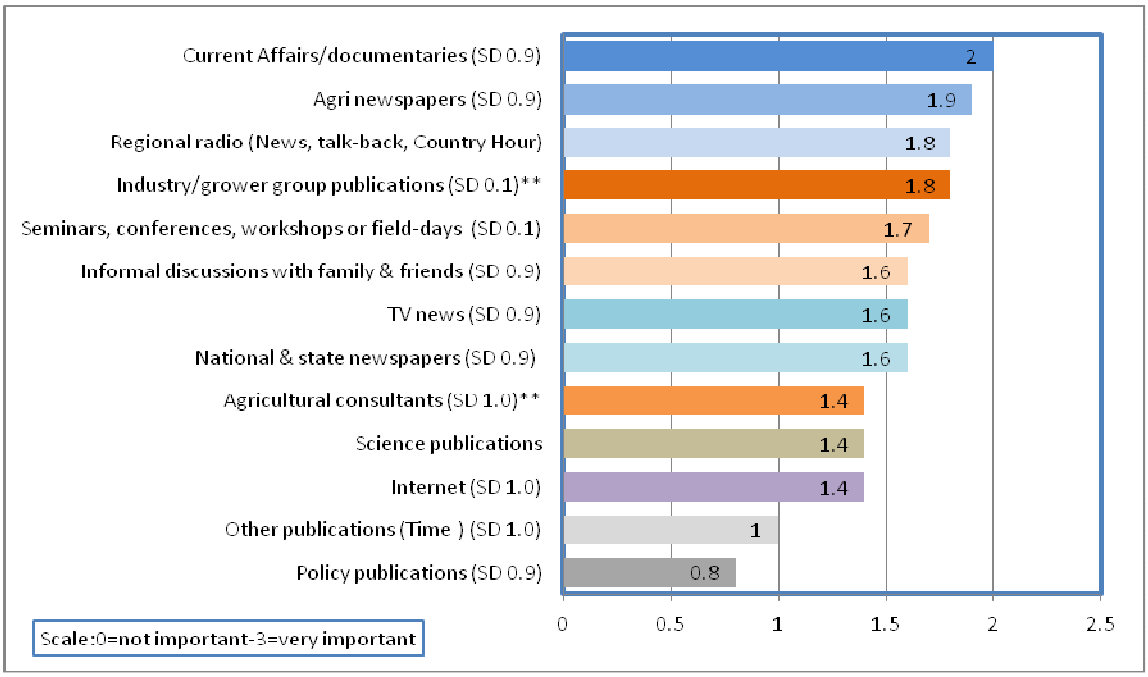


Figure 13.5 Useful climate change information sources
n=383-395**n=238-255farmers

The responses pointed to some inconsistency between the value ascribed to climate change views of various social structures in the study and worth of the information provided by the social structures. Maibach et al.'s (2009) research had proposed attitudes to climate change shaped information and knowledge value characteristics. Essentially as other research (Covello and Johnson, 1987) showed, people were more inclined to use sources that provided information/knowledge that did not conflict with their socio-cultural beliefs/values framework. To see if this was also a contributing influence in this research, an analysis of interdependent associations between characteristics of participants and their information values was undertaken.

Appendix 14: Non-significant personal and local context information/knowledge sources

ANOVA and associated appropriate relevant tests were used to compare responses and see if there were significances of difference between questions. Results indicated there were no significant differences between responses of participants in the clusters concerning values attributed to personally controlled information sources of: family; friends; neighbours; agri-newspapers and TV news (Figure 14.1). Neither were there significant differences in value ascribed to the local context sources of agricultural consultants and community groups.

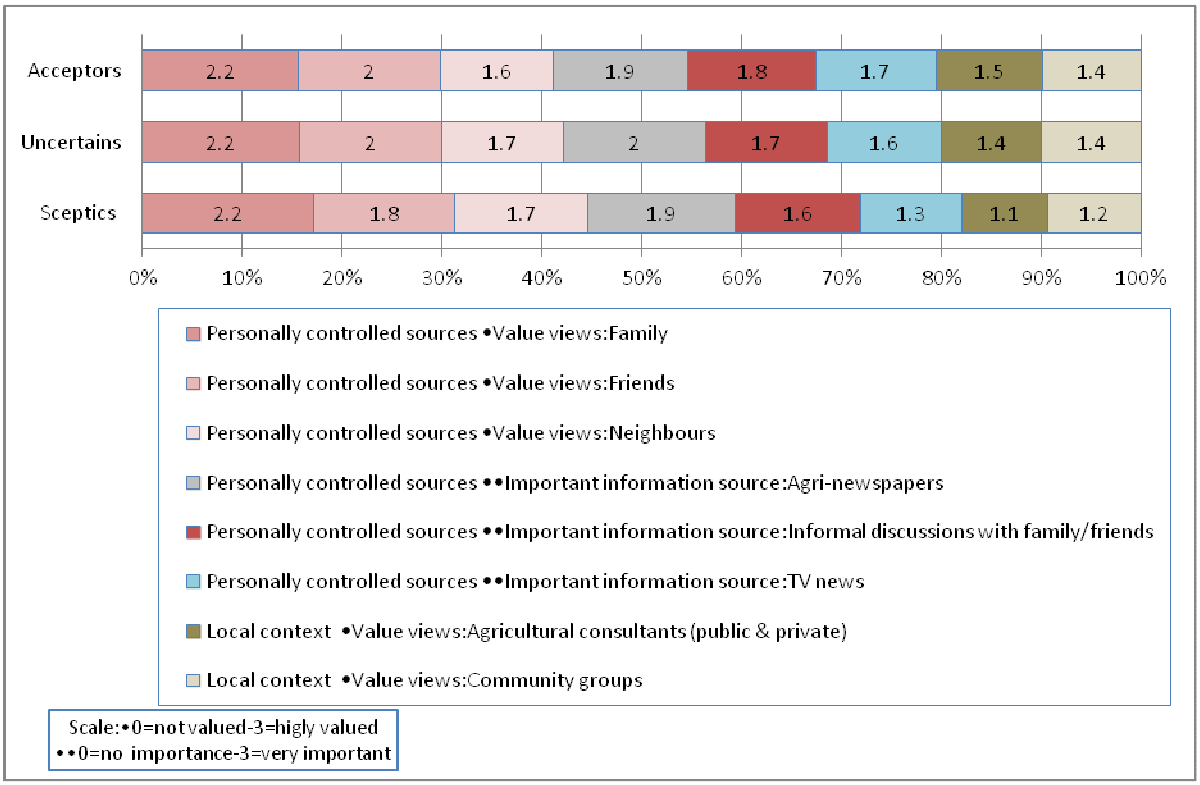


Figure 14.1 Non-significant personal and local context information/knowledge networks
'Acceptors' n=71-74: 'Uncertains' n=199-203: 'Sceptics' n=53-54

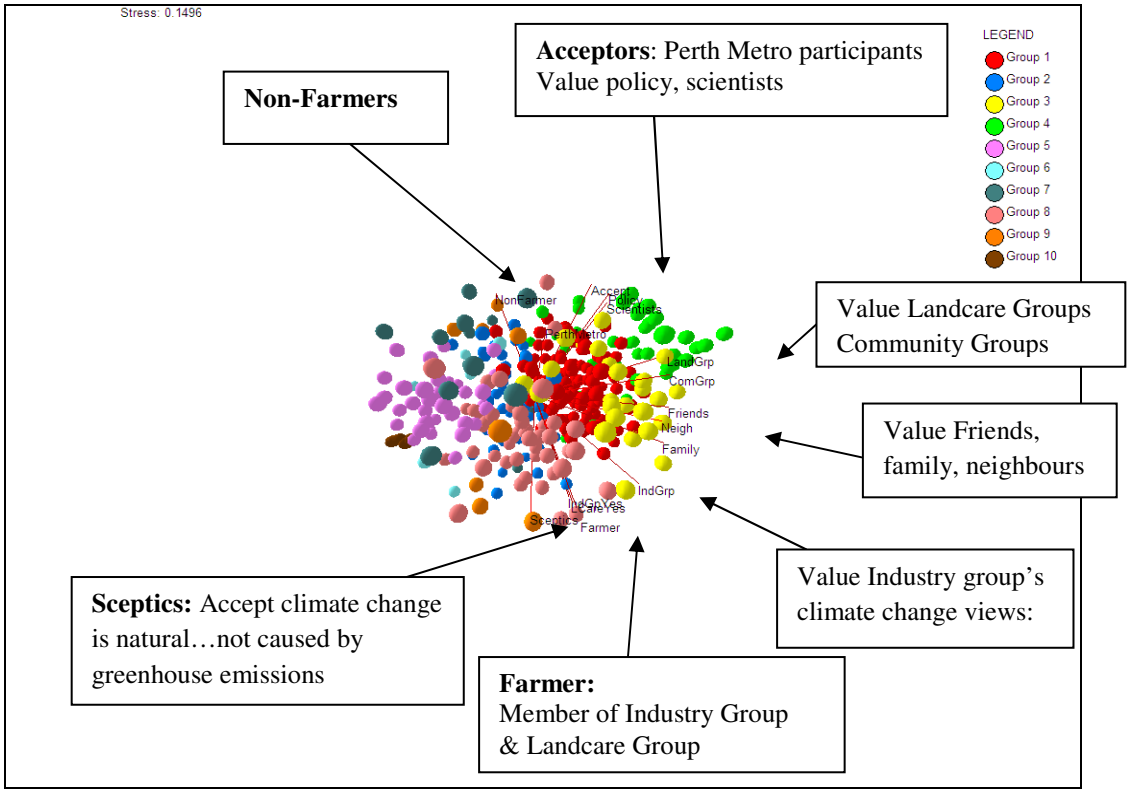
Appendix 15: Information and Knowledge Source Networks

The ordination derived from multivariate analysis (PATN 2.3 Belbin, 1993a) illustrated the differences in information values within and between farmers, non farmer's, 'Acceptors 'and 'Sceptics' (Figure 15.1). The major vectors were drawn from an evaluation of the ordination with variables that were statistically significant attributes of each group that is described in table 15.1.

Table 15.1: Cluster values – labels for information sources

Variable	Variable label
TV News	TV
Current affairs programs, documentaries	AffairDoc
Radio (news, talkback, Country Hour)	Radio
National and state newspapers	NewsPaper
Agri newspapers (Farmers Weekly, Countryman)	AgPaper
Other publications (Time etc)	OtherPub
Science publications (journals, reports)	SciPub
Industry and grower group reports and articles	IndPub
Seminars, conferences, workshops, fielddays	Seminar
Informal discussions with family and friends	FamFriend
Agricultural consultants (private and government)	AgConsult
Federal Governments Carbon Pollution Reduction Scheme Green Paper	GreenPaper

Significant associations between variables are shown at the end of the vector line with the variable name with significant negative associations the linear opposite of the positive relationship variables (Figure 15.1).



SSH MDS, Gower Metric, B = 0.05, UPGMA Stress 0.15 in three dimensions

Figure 15.1 Information and knowledge sources

There were statistically significant difference between farming participants, non-farming participants, Acceptors of climate change and Sceptics who believed climate change was natural. Non-farmers were diametrically opposite farmers on the either point of the vector. Farmer's values indicated they were members of Landcare and industry groups.

Acceptors were almost opposite Sceptics at each end of the vector. Acceptors included a significantly proportionate number of participants who lived in the Perth metropolitan area. 'Acceptors' as a group valued climate change views and opinions of scientists and policy makers. Sceptics on the other hand held the view climate change was natural and not influenced by greenhouse emissions and by the position they occupied opposite Acceptors and Acceptors values on the vector, placed little value on the climate change views of scientists and policy makers.

Between the descriptors of 'Farmer' and Acceptors, on the ordination there is a range of groups of participant's values. Closest to the Acceptors who valued the climate change views of policy and scientists are participants who value the climate change

views of Landcare and community groups. In close proximity to these values and to each other are the participants who value climate change views of friends, family and neighbours. The next set of values which are the climate change views of industry groups are closest to the 'Farmer' descriptor as well as the associated values of belonging to Landcare and industry groups.

The ordination depicted a number of key associations of information/knowledge values with groups of participants. There is a close association between participants who lived in the Perth metropolitan area and Acceptors of climate change with valuing science and policy maker's views on climate change and some separation from 'non-farmers'. This suggested there was a difference in the attitudes to climate change and science and governance of participants from Perth compared to 'non-farmers' who live in rural areas who in turn do not share any value associations with 'farmers'. Essentially the ordination illustrates the presence of three groups based on where participants live, rural or urban, and what participants do, farming or non-farming.