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Understanding climate change adaptation as a national challenge

Climate Adaptation Flagship Working Paper #8

Helping Australia Adapt to a Changing Climate

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National Library of Australia Cataloguing-in-Publication entry

Title:	Understanding climate change adaptation as a national challenge / Sarah Park … [et al].
ISBN:	978-0-643-10687-1 (pdf)
Series:	CSIRO Climate Adaptation Flagship working paper series; 8.
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Citation

This document can be cited as:

Park, S.E., Crimp S., Dowd, A-M., Ashworth, P., Mendham, E. (2011) Understanding climate change adaptation as a national challenge. CSIRO Climate Adaptation Flagship Working paper No. 8. http://www.csiro.au/resources/CAF-working-papers.html

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Important disclaimer

Contents

List of Figures

List of Tables

Acknowledgements

The authors would like to thank the National Climate Change Adaptation Research Facility, Climate Adaptation Flagship, and Department of Climate Change and Energy Efficiency for their cooperation in this research. Particular thanks go to all the survey respondents and workshop participants for their enthusiastic collaboration. Funding contributions from the CSIRO Climate Adaptation Flagship and CSIRO Ecosystem Sciences are kindly acknowledged

EXECUTIVE SUMMARY

The research detailed in this summary report aims to identify and synthesise key challenges of relevance to climate change adaptation in Australia in a holistic and multi-thematic/sectoral manner, as a means to informing policy decision-making and research investment. The research was undertaken in association with the 2010 Climate Adaptation Futures Conference (29 June to 1 July 2010, Gold Coast, Australia). The research was conducted in collaboration with representatives from the three key communities necessary for promoting evidence-based policy decision-making at all levels of society, namely practitioners, policy developers and scientists.

Forty-four key climate change adaptation challenges were identified for Australia. These span six of the country's main sectors. Representatives from the sectors identified the need for enhanced coordination in developing, implementing and monitoring adaptation responses that effectively integrate to address cross sectoral impacts, synergies and trade-offs. The need to integrate across multiple scales was seen as central in this respect.

The challenges were individually scored in terms of their relative priority and achievability. The priority ratings attributed to the forty-four challenges indicate a broad range of urgency with which the challenges need to be addressed. No particular challenge from any one sector was perceived as being either predominantly 'high' or 'low' in terms of priority. Whilst all forty-four adaptation challenges were considered 'achievable', the average level of effort required to tackle them is likely to be 'moderate' to 'extreme'. (See main text for definitions relating to these terms.)

There was no correlation between the 'priority' and 'achievability' ratings of the forty-four key climate change adaptation challenges. This means the highest priority adaptation challenges will not necessarily be the easiest to achieve. Understanding likely trade-offs, synergies, unintended outcomes and the management issues associated with each challenge will therefore be critical in determining how and when, limited resources might be best invested within the context of a national adaptation strategy.

1. UNDERSTANDING CLIMATE CHANGE ADAPTATION AS A NATIONAL CHALLENGE

Australia has begun to address the wicked problem of adapting to climate change through a range of nationally funded activities and programs, such as the Department of Agriculture, Fisheries and Forestry's (DAFF), Australian Climate Change Science Program (ACCSP), the National Climate Change Adaptation Research Facility's (NCCARF) National Adaptation Research Plans (NARPs), and research conducted within the Commonwealth Scientific and Industrial Organisation's (CSIRO) Climate Adaptation Flagship. However, the research within these programs is largely thematic, sectoral in nature or industry-based, and in some case does not capture the full complexity of the economic, social and ecological issues or the interactions within and between them. As a consequence, it is likely that potential efficiencies in adaptation planning and implementation will be inadvertently overlooked. Consideration for unintended and maladaptive consequences occurring is also likely to be inadequately addressed.

Many of the current planning activities are primarily concerned with the identification of the scale and extent of impacts (Pearson et al., 2010). While this is a fundamental step in identifying vulnerability, as an isolated activity, impact assessment fails to align science output with the cross-sectoral information needs of practitioners and decision-makers to produce appropriate adaptation response strategies. Consequently, decision-makers are faced with investing private and public funds into the development and implementation of tactical and strategic climate change adaptation strategies in the absence of a holistic perspective of the key issues from a social, science research and policy perspective.

In order to build upon previous adaptation research and provide a cross-sectoral perspective on the key climate change adaptation issues of policy relevance to Australian society, the CSIRO Climate Adaptation Flagship undertook this research at the 2010 Climate Adaptation Futures Conference (29 June to 1 July 2010, Gold Coast Australia). This enabled a wide range of perspectives on strategic science and policy issues related to climate change adaptation, to be captured from the breadth of national and international delegates attending the conference. Progress made by other countries in developing national adaptation strategies was seen as providing a valuable perspective on the challenges likely to be faced in Australia.

1.1 Research aims

The Climate Adaptation Challenges research project aimed to identify and synthesise key challenges relevant to climate change adaptation in Australia in a holistic and multi-thematic/sectoral manner, as a means to informing policy decision-making and research investment. A key feature of the research was the collation of a range of views drawn from a broad spectrum of domestic and international interest groups and sectors of society. The aim of project was addressed by undertaking two key tasks:

- Identifying important climate change adaptation challenges of policy relevance, social concern and R&D importance for Australia at both strategic (defined here as five to ten years) and tactical (three to five years) timeframes;

- Exploring the interactions (potential efficiencies, trade-offs and unintended consequences) likely to occur across thematic areas/sectors and the implications for a comprehensive nested policy response.

2. METHODS

Three key activities were used to identify and synthesise perspectives on the key challenges of policy relevance relating to the development of a national climate change adaptation strategy for Australia (Fig. 1). These activities included:

- Online and telephone pre-workshop surveys to elucidate the views of a sample of community leaders, and representatives from the science, policy and practitioner community;
- A one-day workshop attended by fifty nine conference delegates considered experts in the field of climate change adaptation and selected for their collective broad range of disciplinary backgrounds, geographic foci, and interest in climate change adaptation;
- An online evaluation survey completed by the workshop participants to communicate their perception of the efficacy of the workshop format to identify key adaptation challenges from a national perspective, and the usefulness of the output produced at the workshop.

The three activities were combined to provide a wide range of views on the challenges facing adaptation in Australia. Importantly, the activities enabled engagement with representatives from the three key communities necessary for promoting evidence-based policy decision-making at all levels of society, namely practitioners, policy developers and scientists.

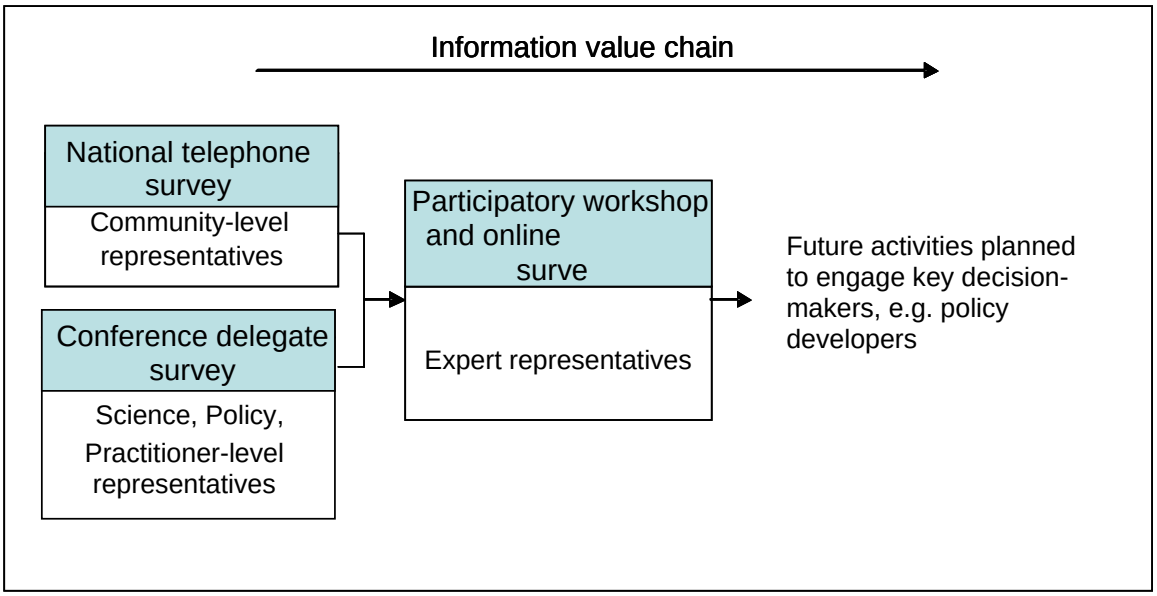

Figure 1:. The information value chain approach undertaken to collate a range of perspectives on the climate change adaptation challenges of policy relevance facing Australia.

2.1 On-line pre-workshop survey

All participants at the 2010 Climate Adaptation Futures Conference were invited to complete an online pre-workshop questionnaire aimed at collating their views on key climate change adaptation challenges of social and research importance for both strategic and tactical policy decision making in Australia. The questionnaire was anonymous, but given the nature of the conference and the sectors that respondents identified as being most relevant to their area of work, this sample group were considered to represent a broad range of practitioner, policy development and science communities.

The respondents to the online survey were asked to:

Identify up to seven key challenges (in order of importance) needing to be addressed from an adaptation perspective, together with any issues likely to be faced when developing and implementing tactical (3-5 years) and strategic (5-10 years) policy and management response actions.

It is important to note that if the respondent selected more than one primary or secondary sector it was not possible to determine if the key challenges identified related to one or several sectors selected. The sectors identified by respondents of the online pre-workshop survey are included in Figure 2.

2.2 Telephone pre-workshop survey

A database was purchased containing the telephone numbers of the national head offices of all organisations and associations in Australia. From this, we identified those organisations and associations likely to be involved in making decisions regarding climate change adaptation that would impact their members, or members of society more broadly. One hundred and eight Chief Executive Officers from this sub-set of relevant organisations and associations were engaged in a pre-workshop telephone survey. The telephone survey was similar to the online version produced for the conference delegates. Respondents of the telephone survey were asked to name the sectors they most identified with. The results from this are included in Figure 2. This sample group of respondents were considered to primarily represent members of the practitioner community.

The respondents to the phone survey were asked:

What does your organisation see as the key challenges that Australia will face in adapting to climate change in the next three to five years?

What are the challenges your organisation sees will need to be faced in your sector area as we move to a longer term horizon (5-10 years)?

If the respondent indicated that they identified with more than one sector, the above questions were repeated up to three times for each sector. Therefore, key challenges identified were sector specific.

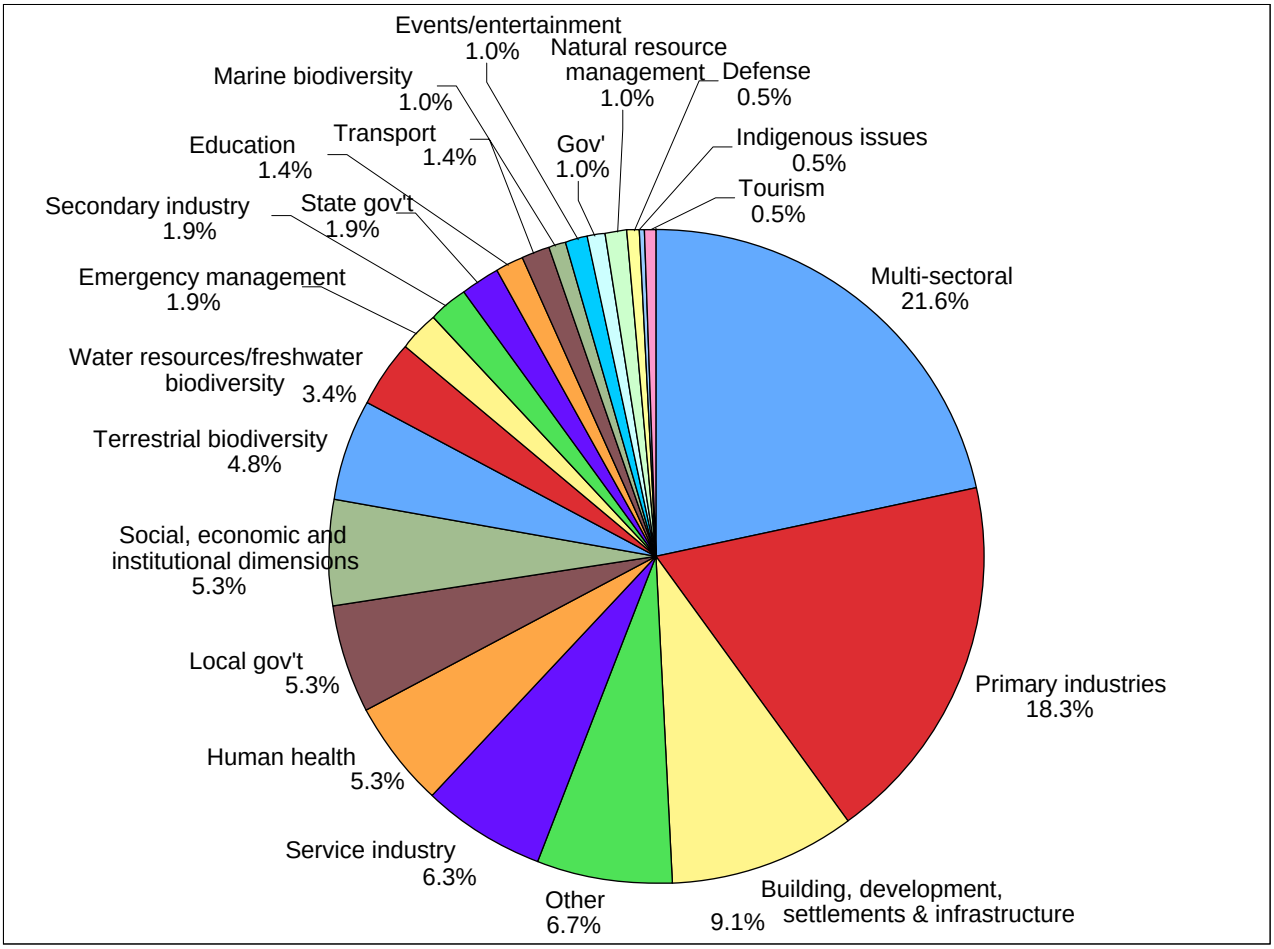

Figure 2: The sectors represented by the respondents of the online and telephone surveys. If a respondent selected more than one option they were classified as 'multi-sectoral'. The category 'Other' contains sectors that only one respondent identified with. Number of telephone respondents = 108; number of online respondents = 100; total number of pre-workshop respondents = 208.

2.3 Pre-workshop surveys – analysis

The large amount of qualitative data obtained from the online and telephone surveys was collated and synthesised into categories to identify common key patterns and themes through a coding technique (Minichiello et al., 1995; Nagy Hesse-Biber & Leavy, 2004; Patton, 1990; Rossman & Rallis, 2003). During this process codes were generated for the key challenges identified by the survey respondents. Several rounds of coding were conducted. For example, several respondents identified the need to better understand how decisions were made. These responses were coded as either '*identifying decision triggers*' or '*understanding decision making in public agencies*' depending on the nuances expressed in the comments. Both codes were then subsequently grouped under a broader theme entitled *'Supporting evidence-based decision making'* (Fig. 3). This process of analysis resulted in a final list of 20 key challenges.

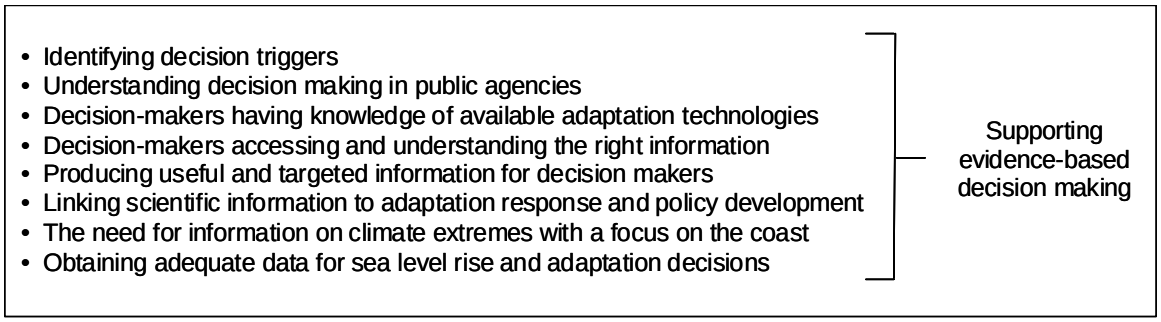

Figure 3: Example of the coding method used to synthesise into categories the qualitative data obtained from the online and telephone surveys.

2.4 Participatory workshop

The workshop format used to engage fifty nine international experts in climate change adaptation science and practice in identifying key challenges for Australia, drew upon a widely used methodology aimed at collaboratively capturing key questions of research, development and policy relevance related to national issues. This approach, sometimes referred to as horizon-scanning, has been used to provide information for policy and practice development in the environment and conservation arenas (Sutherland et al., 2006; Sutherland et al., 2009a; Morton et al., 2009; Sutherland et al., 2009b, Sutherland et al., 2010). Conferences are noted as an effective forum for undertaking horizon-scanning activities (Sutherland and Woodroof, 2009).

The sixty individuals invited to the workshop were selected from delegates attending the 2010 Climate Adaptation Futures Conference. The organisations and sectors represented by the workshop attendees are included in Appendix A. The proportion of each sector represented at the workshop is shown in Figure 4.

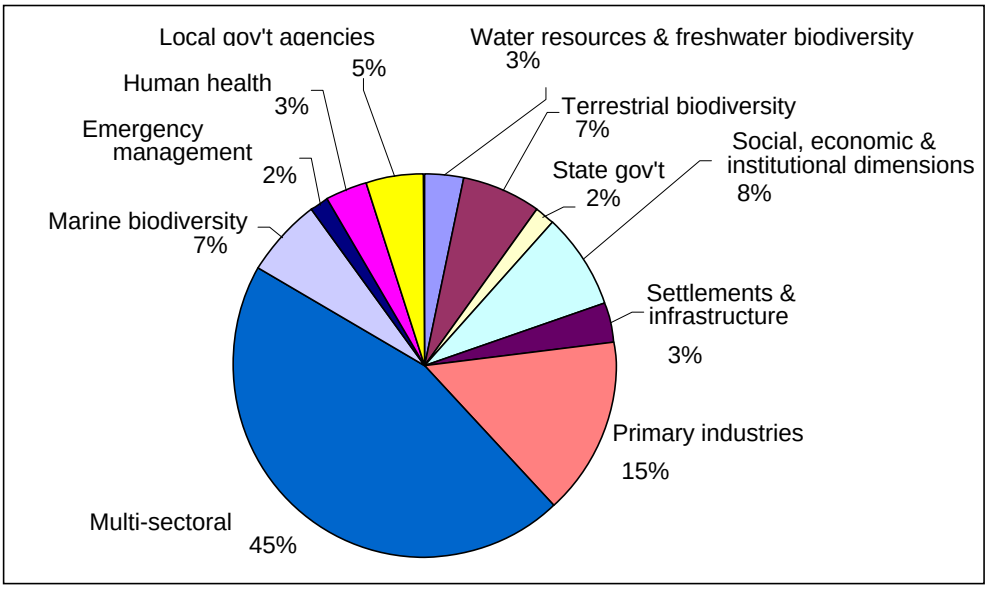

Figure 4: The sectors represented at the one-day workshop. If a respondent selected more than one option they were classified as 'multi-sectoral. The category 'Other' contains sectors which only one respondent identified with. Total number of workshop participants = 59.

The one-day workshop was split into three distinct sets of activities. In the morning, participants identifying with similar sectors and themes were seated together. This resulted in approximately ten participants being allocated to each of six tables based on the following sectoral themes:

- Local and state government
- Social, economic and institutional dimensions
- Marine and terrestrial biodiversity
- Urban environments (including water resources, freshwater biodiversity, settlements, infrastructure and human health)
- Primary industries
- Multi-sectoral

The members of the six sectoral/thematic-based teams were asked to identify up to ten of the key challenges facing their sector/theme from either the pre-workshop survey, or by supplementing ideas from their own knowledge and experience. When doing this, the participants were also asked to note the criteria they used to evaluate and prioritise their selection.

Once each team had agreed upon their key challenges, the team members were asked to:

- classify whether each challenge required addressing in either three to five years time (requiring tactical response strategies), or five to ten years (requiring strategic response strategies);
- identify issues needing to be considered in relation to managing each challenge, and

- identify other sectors/themes that would need to be involved in planning and implementing adaptation response strategies for each challenge.

The challenges identified by each of the sectoral/thematic teams were presented by a self-nominated member of each team for consideration and comment by all workshop participants.

In the first half of the afternoon, all participants were moved from their sectoral/thematic teams and randomly allocated to another team in order to produce six new multi-sectoral teams. The challenges identified in the morning activities were also randomly allocated to the six multi-sectoral teams. The multi-sectoral teams were asked to identify:

- issues, trade-offs and mal-adaptations, and synergies and opportunities likely to occur when addressing each challenge from a multi-sectoral policy perspective;
- research and development foci required to inform decision-making regarding each challenge, and
- whether each challenge required addressing in either three to five years time, or five to ten years.

The third stage of the workshop involved the participants independently voting (using an electronic handheld DigiVote console) on the relative manageability and priority of each of the challenges identified in the workshop. While participants were asked to enter their sector/thematic team name into the voting console, no additional personal details were entered; therefore the voting exercise produced anonymous data. The voting procedure required each participant to firstly determine the manageability of each challenge using a scale of one to five (where, 1 = not achievable; 2 = achievable but requires extreme effort; 3 = achievable but requires significant effort; 4 = achievable with moderate effort; 5 = achievable), and then determine the priority required for action to be taken on each challenge using a scale of one to nine (where, 1 = low priority, and 9 = high priority).

2.5 Workshop evaluation

After the workshop, participants were invited to complete an online evaluation questionnaire containing twenty-five questions relating to:

- the effectiveness of each activity in capturing their perspective;
- the level of difficulty in reaching agreement between group members; firstly within the sectoral teams, and then the multi-sectoral teams;
- the extent of inclusion of the challenges identified in the pre-workshop surveys, within their own selection of key challenges;
- the usefulness of the workshop output and the likelihood that they would use it to inform future decision-making processes and/or decisions regarding climate change adaptation actions.

3. SUMMARY OF WORKSHOP OUTCOMES

The following provides a brief summary of the output produced during this study. Initial analysis has been conducted on the data, and a selection of results presented. Further analysis is ongoing and will be submitted for publication in a CSIRO Climate Adaptation Flagship Working Paper (available from 5 August 2011 at www.csiro.au/resources/CAF-working-papers) and in a peer-reviewed journal paper.

3.1 Key challenges identified in pre-workshop surveys

The twenty key climate change adaptation challenges identified by respondents of the pre-workshop surveys are listed in Table 1 (in no particular order).

Table 1: Key challenges identified from the pre-workshop surveys.

No.	Challenge theme
1	Getting a broad consensus and acceptance of climate change
2	Determining the impacts of climate change (e.g. erosion, extreme events, heat, sea level rise, ocean acidification)
3	Gaining widespread acceptance of the need for adaptation
4	Understanding human behaviour in response to climate change
5	Building adaptive capacity
6	Devising ways to develop adaptation options
7	Understanding the outcomes resulting from adaptation actions
8	Supporting evidence-based decision making
9	Making accurate data easily accessible
10	Progressing climate science and climate change projections
11	Improving the communication of science and an understanding of how it can be used
12	Engaging with decision makers
13	Integrating adaptation response actions into planning
14	Implementing a multi-sectoral approach
15	Working within the constraints of insufficient funding
16	Assisting primary industries to adapt to changing (drier) conditions
17	Managing water resources
18	Maintaining biodiversity and the conditions and functioning of natural resources
19	Managing shortages
20	Integrating adaptation and mitigation actions

3.2 Key challenges – workshop output

After consulting the list of challenges produced from the pre-workshop surveys, the workshop participants identified a second list of forty-four key challenges (Table 2).

Table 2: Key challenges identified by the workshop participants and the criteria used to prioritise them.

No	Challenge	Criteria used to prioritise
Primary Industries		
1	Adapting to changing water availability	▪ A change that requires a major action (or policy change) that can be identified ▪ Urgency ▪ Addressing a removable barrier (including political barriers) ▪ Be able to identify what success looks like (and community should be able to recognise this as well). ▪ Clear pathway to interaction with adaptation decision-makers ▪ Likely to cross sectors/ disciplines ▪ Effects and impacts should be measurable
2	Human and social network capacity building	
3	Acceptance of a need to act	
4	Achieving sustainability, incorporating economic viability	
5	Improving the mental health of rural communities	
6	Identifying the most effective options for behaviour at the farm level	
7	Identifying the most effective options at the non-farm scale	
8	Addressing the disconnect between rural and urban sectors	
9	Recognising limits to adaptation	
10	Linking mitigation and adaptation	

No	Challenge	Criteria used to prioritise
Marine and terrestrial biodiversity		
11	Understanding the links between biodiversity, resilience, ecosystem function	• Level of vulnerability/importance of risk to objectives • Proximity of risk (at what point in time is our objective likely to be compromised?) • Effort required (resources, barriers to be overcome etc) • Flexibility (time to successfully respond, and to modify response if necessary) • Co-benefits of response • Likelihood of response successfully addressing the risk • Number of high priority risks addressed by response • Overarching aim: Maintain goods and services through the maintenance of global biodiversity and healthy ecosystems
12	Recasting conservation to focus on ecosystem function	
13	Managing change in biological communities (including extinction) and knowing when to change approach	
14	Communicating that humans are part of the ecosystem and dependent on it	
15	Managing expectations of adaptation (no magic bullet)	

No	Challenge	Criteria used to prioritise
Social, economic and institutional dimensions		
16	Resourcing decisions. Understanding who will be the winners/losers? (and values)	No criteria produced
17	Adaptive learning across scales from the community to household; science funding; learning from previous strategies	
18	Making smart decisions: understanding who should be involved?	
19	Balancing multiple stressors	
20	Understanding the differences between transformation versus incremental changes	
21	Government co-ordination at all levels; (need for appropriate strategies at regional level depending on local/regional issues)	
22	Integrating culture and capacity. Dealing with laggards	
23	Dealing with barriers to change and inertia	
24	Getting value for money: monitoring and evaluation, costs and benefits	
25	Developing process-focused policy	

No	Challenge	Criteria used to prioritise
Urban environments (including water resources, freshwater biodiversity, settlements, infrastructure and human health)		
26	Developing understanding of climate change and adaptation planning that incorporates multiple perspectives equitably	• Adaptation through modifications versus larger scale transformation or restructure • Time scale for response and action (may need to consider generational scale also) • Time scale of impact • Cost of no action verses action • Level of (relative?) uncertainty and degree of consequences • Equity and scale of issue • Community understanding among stakeholders
27	Understand how population increases and migration feature in adaptation planning	
28	Understand what strategic urban and regional planning looks like with respect to changing land use patterns and competing visions for the future	
29	Developing knowledge for practice that addresses under-insurance and appropriate use and development of building codes at the appropriate level of abstraction (e.g. local versus federal government)	
30	Developing proactive approaches to climate change issues and consequent adaptation planning	
31	Bridging the cross-scale gaps/disconnect between stakeholders	
32	Incorporating social vulnerability into equitable adaptation planning	

No	Challenge	Criteria used to prioritise
Local and state government		
33	Matching risk (mostly at Local Government Authority level) and the resources, power (legislative) and funds	• Turning barriers into enablers • Achieving sufficient control and resources to facilitate change • Ability to use existing systems where possible • Needs to have political backing • Equity • Knowing what success looks like • Matching risk with resources • Ability to choose efficient methods to address a challenge
34	Influencing the agenda of government(s)	
35	Identifying where in governance system the 'what' of adaptation (e.g. research, planning, information, works, advocacy) best occurs (i.e. effectively, efficiently, equitably)	
36	Modifying the current governance system to support (rather than paralyse) action where it is required	
37	Identifying thresholds for action	
38	Transitioning from a non-adaptive to adaptive state/condition/mindset	
39	Transitioning from (a situation characterised by) barriers to enablers of action	
40	Integrating sectoral issues and governance complexity to succinct identification and communication of objectives	
41	Overcoming the problems of governance inertia (e.g. moral hazard)	
42	Motivate community action	

No	Challenge	Criteria used to prioritise
Multi-sectoral		
43	Building collaborative capacity (e.g. within community, science, government)	• Long-term perspective of challenge • Intersecting actions • Acknowledging uncertainty (flexibility – adaptive management) with regard to the outcome • Need for an immediate response (given best current science) • Measures which have co-benefits across sectors, scale and time and which address both adaptation and mitigation in an integrated manner • Looking for opportunities (proactive verses reactive)
44	Creating resilient networks, e.g. though building awareness of climate change, and taking a long term perspective on education	

There was strong agreement between many of the challenges identified by broader society and those identified by the workshop experts. These focused around the following topics:

- Building awareness of climate change and an understanding of the possible impacts, as well as gaining consensus that society will need to adapt;
- Recognising the influence of human behaviour on the outcomes of adaptation strategies and building this understanding into the development of adaptation strategies;
- Building the capacity of society (at multiple levels) to adapt;
- Devising methods and processes that will enable adaptation options to be developed, evaluated and implemented;
- Developing planning and governance processes that support decision-making and action;
- Developing coordinated adaptation planning and response strategies that take into account multiple sectors, stressors, perspectives and competing visions for the future, whilst also integrating across scales and delivering equitable outcomes;
- Adapting the management of water resources to take account of changes in availability;
- Producing efficient adaptation outcomes from limited financial and other resources;
- Maintaining biodiversity and the conditions and functioning of natural resources;
- Integrating adaptation and mitigation planning and actions.

Whilst the aim of the six teams in the morning session of the workshop was to identify specific challenges for their sector/theme, there was one general topic identified (to varying degrees) across the majority of the teams. This was the need for *coordinated processes for developing integrated adaptation response actions*. The need to integrate across multiple scales was particularly noted in this respect.

3.3 Criteria used to evaluate importance of adaptation challenges from a sector perspective

Given the array of challenges identified by the workshop sector/thematic teams, it is interesting to note the criteria used by each of them to rank their order of importance (Table 2). Comparing this list of criteria highlights the wide array of values and attitudes present between different focus groups in society. The diversity in this list indicates the potential ease (or difficulty) likely to be faced in developing and implementing multi-sectoral adaptation actions that are valued equally by all of society.

Whilst there are some sector-specific criteria (e.g. maintaining goods and services through the maintenance of global biodiversity and healthy ecosystems, and having political backing), the vast majority of criteria are generic in nature. Themes running through these generic criteria focus on the:

- Ability to identify the required change and the pathways for implementation;
- Level and proximity of urgency, risk, vulnerability (compared to the resources required for adaptation);

- Ability to identify what success looks like, and be able to measure if it is achieved;
- Likelihood of an action resulting in successful adaptation;
- Likely co-benefits from the outcomes of an adaptation strategy (and the equitability of these) across sectors and disciplines;
- Ability to address a number of risks with one adaptation action;
- Availability of resources required to address a challenge (including the efficiency with which it can be deployed);
- Community and political understanding and support for the adaptation option.

The common themes identified from the criteria used by the six sectors/thematic teams offers a basis for integrating past sectoral-focused activities and programs (e.g. ACCSP and NARP), and optimism for the future development of national adaptation response strategies.

3.4 Priority and achievability of key challenges

In order to produce a single priority list of challenges from a national perspective, all participants scored anonymously the relative priority and achievability of all forty-four key challenges. The mean scores from this activity are shown in Table 3, and the relationship between priority and achievability for each challenge is shown in Figure 5.

Table 3: Mean score for the priority (urgency) and achievability of the key challenges as perceived by the workshop participants. The voting procedure required each participant to firstly determine the manageability of each challenge using a scale of one to five (where, 1 = not achievable; 2 = achievable but requires extreme effort; 3 = achievable but requires significant effort; 4 = achievable with moderate effort; 5 = achievable), and then determine the priority required for action to be taken on each challenge using a scale of one to nine (where, 1 = low priority, and 9 = high priority).

No.	**Key adaptation challenges**	Mean priority rating	Mean achievability rating
1	Adapting to changing water availability	7.5	2.9
43	Building collaborative capacity (e.g. within community, science, government)	7.1	3.3
3	Acceptance of a need to act	6.6	2.9
21	Government co-ordination at all levels; (need for appropriate strategies at regional level depending on local/regional issues)	6.6	2.7
30	Developing proactive approaches to climate change issues and consequent adaptation planning	6.3	3.5
42	Motivate community action	6.3	3.4
4	Achieving sustainability, incorporating economic viability	6.3	2.4
44	Creating resilient networks, e.g. through building awareness of climate changle, and taking a long term perspective on education	6.2	3.4
34	Supporting information needs of governments and communities(Formerly: Influencing the agenda of government(s))	6.2	3.1
23	Dealing with barriers to change and inertia	6.1	2.8
10	Linking mitigation and adaptation	6.0	3.5
2	Human and social network capacity building	6.0	3.2
36	Modifying the current governance system to support (rather than paralyse) action where it is required	6.0	2.5
18	Making smart decisions: who should be involved?	5.9	3.8
14	Communicating that humans are part of the ecosystem and dependent on it	5.9	3.6
27	Understand how population increases and migration feature in adaptation planning	5.9	3.6
37	Identifying thresholds for action	5.8	2.9
32	Incorporating social vulnerability into equitable adaptation planning	5.7	3.2
19	Balancing multiple stressors	5.7	2.6
33	Matching risk (mostly at Local Government Authority level) and the resources, power (legislative) and funds	5.7	2.3
9	Recognising limits to adaptation	5.6	3.1

No.	Key adaptation challenges	Mean priority rating	Mean achievability rating
11	Understanding the links between biodiversity, resilience, ecosystem function	5.5	2.9
26	Developing understanding of climate change and adaptation planning that incorporates multiple perspectives equitably	5.5	2.8
39	Transitioning from (a situation characterised by) barriers to enablers of action	5.5	2.6
31	Bridging the cross-scale gaps/disconnect between stakeholders	5.4	2.7
13	Managing change in biological communities (including extinction) and knowing when to change approach	5.4	2.5
15	Managing expectations of adaptation (no magic bullet)	5.2	3.7
24	Getting value for money: monitoring and evaluation, costs and benefits	5.2	3.5
28	Understand what strategic urban and regional planning looks like with respect to changing land use patterns and competing visions for the future	5.2	3.1
16	Resourcing decisions. Understanding who will be the winners and losers? (and values)	5.2	2.7
41	Overcoming the problems of governance inertia (e.g. moral hazard)	5.2	2.4
38	Transitioning from a non-adaptive to adaptive state condition/mindset	5.1	2.9
8	Addressing the disconnection between rural and urban sectors	5.0	2.9
7	Identifying the most effective options at the non-farm scale	5.0	2.6
35	Identifying where in the governance system the ‘what’ of adaptation (research, planning, information, works, advocacy) best occurs (effectively, efficiently, equitably)	4.9	3.4
12	Recasting conservation to focus on ecosystem function	4.8	3.5
29	Developing knowledge for practice that addresses under-insurance and appropriate use and development of building codes at the appropriate level of abstraction (e.g. local verses federal government)	4.8	3.3
17	Adaptive learning across scales from the community to household; science funding; learning from previous strategies	4.8	3.0
5	Improving the mental health of rural communities	4.6	3.0
20	Understanding the differences between transformation versus incremental changes	4.3	2.0
6	Identifying the most effective options for behaviour at the farm level	4.0	3.7
25	Developing process-focused policy	3.7	2.4

No.	Key adaptation challenges	Mean priority rating	Mean achievability rating
40	Integrating sectoral issues and governance complexity to succinct identification and communication of objectives	3.7	2.4
22	Integrating culture and capacity. Dealing with laggards	3.4	2.3

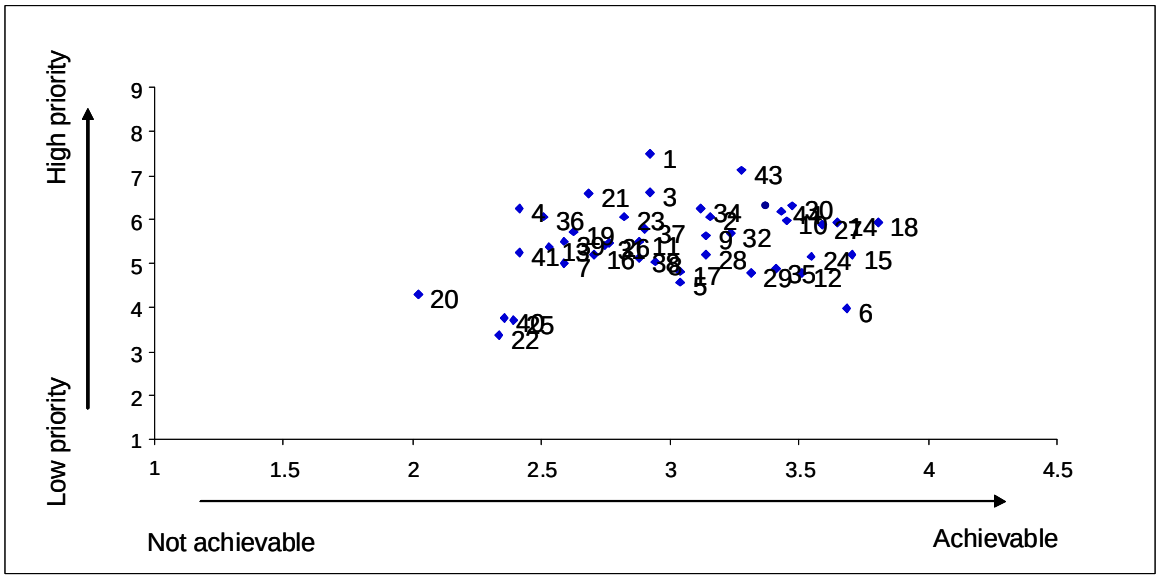

Figure 5: Achievability and priority mean ratings for the forty four key challenges.

The priority ratings attributed to the forty-four challenges indicate a perceived broad range of urgency with which the challenges need to be addressed. No particular challenge from any one sector was perceived as being predominantly high or low in order of priority. All of the challenges were rated at least medium to low priority, indicating a general consensus among the workshop participants that all forty-four challenges need to be addressed in order to enhance the capacity of Australian society to adapt to climate change.

Whilst all forty-four adaptation challenges were considered achievable, the average level of effort that would be required spans from moderate (e.g. 'managing expectations of adaptation' and 'identifying the most effective options for behaviour at the farm level'), to extreme (e.g. 'ability to identify and implement transformation versus incremental changes).

There was no correlation between the priority and achievability ratings attributed to the forty-four key challenges. For example, the top priority challenge (adapting to changing water availability, mean priority rating 7.5) ranked only twenty-second out of the forty-four challenges for achievability (mean achievability rating 2.9). Of the top ten priority challenges, only one was also considered to be within the top ten most achievable (i.e. developing proactive approaches to climate change issues and consequent adaption planning, ranked 9th achievable, mean achievability rating 3.5).

The lack of a correlation between priority and achievability means that the highest priority adaptation challenges are not necessarily the easiest to achieve. Understanding likely trade-offs,

synergies, unintended outcomes and the management issues associated with each challenge will therefore be critical in determining how and when, limited resources might be best invested within the context of a national adaptation strategy.

3.5 Additional information to inform decision-making

All forty-four key challenges were considered by the workshop participants in terms of:

- the need to implement tactical (either three to five years) or strategic (five to ten years) response strategies;
- issues needing to be considered in relation to managing the challenge;
- other sectors/themes that need to be involved in planning and implementing adaptation response strategies;
- likely trade-offs, unintended outcomes, synergies and opportunities likely to occur when addressing the challenge from a multi-sectoral policy perspective; and
- research and development foci required to inform decision-making in relation to the challenge.

Given limited resources are available for the development, implementation and evaluation of adaptation strategies, and the difficulty in eliciting a definitive ranking of challenges in terms of both priority and achievability, the above information may provide a useful additional resource for policy-makers looking to employ evidence-based decision-making in their attempts to enhance the adaptive capacity of Australian society to climate change.

Box 1 provides an example of how this additional information may help decision-makers evaluate the relative merits of investing in the development, implementation and evaluation of adaptation strategies aimed at addressing each of the forty-four key challenges from a national perspective. The highest raked priority challenge (adapting to changing water availability) is used in this example.

BOX 1: Using the highest priority sectoral challenge as an example of how the workshop participants considered key adaptation challenges for Australia within a national (i.e. multi-sectoral) context.

Adapting to changing water availability is the highest priority climate change adaptation challenge facing Australia today, receiving an overall rating of 7.5 out of 9. The participants identified this issue as requiring 'significant' to 'extreme' effort to resolve and also identified the existing barriers and synergies required to expedite response actions. The participants identified the cross sectoral interactions required and the critical timelines within which significant actions needed to be taken. The information that follows provides some detail around these.

Who will need to be involved in developing, implementing and evaluating adaptation actions?

Whilst this challenge was initially identified by the Primary Industries sector as being key to national adaptation in Australia, many sectors of society depend on water resources, and will therefore need to be involved in developing, implementing and/or evaluating a national response strategy. These sectors include those working in marine biodiversity, emergency management, settlements and infrastructure, social, economic and institutional services, human health, water resources and freshwater biodiversity, terrestrial biodiversity, Indigenous services, as well as local, state and federal government agencies.

What management issues will need to be addressed by these multiple actors?

A key issue that will need to be managed is variability in the supply of water (both seasonally and spatially) and the disjoint between what may happen to future rainfall and the implications for both surface and groundwater recharge. These factors will impact the balance of water available to urban and rural users. Management of variable water resources will also need to consider the quality of available water. The allocation of water between different users in society may affect the migration of populations around the country. A broader perspective of water users may include consideration of the amount of water that is embedded in goods exported from Australia.

Can we expect any trade-offs, un-intended consequences, synergies across sectors, or opportunities to arise from the changing availability of water?

One consequence of the changing availability of water is that the total cost of making water available to users in both urban and rural environments will need to be more effectively accounted for. Limited supplies mean there will be an inevitable trade-off between the needs of biodiversity conservation and activities such as farming. Possible maladaptation may manifest in significant loss of agricultural productivity; population shifts; and potential changes in economic prospects for both urban and rural communities. However, if water issues can be addressed successfully at the national level, this may better support the nations' attempts at attaining sustainable agricultural production, as well as other industries and urban and rural communities in Australia. Tackling the issue may offer opportunities to consider differentiating the quality of water required for different uses.

What are some of the issues and approaches that policy-developers and R&D providers need to consider?

Those planning and developing policy to support adaptation strategies in this area, will need to consider how future growth in population and changes in migration patterns will impact water demands. Undertaking research to map where population growth corridors are occurring, and where water is available may inform decision making from a national perspective. Research into the impacts of environmental flows may also help in understand water needs.

4. WORKSHOP EVALUATION

Thirty (just over 50%) of the workshop participants completed the online evaluation survey for the workshop. In summary:

- Up to 60% of those responding to the evaluation survey rated the eight activities aimed at capturing the participant's perspectives on a suitable criteria for identifying sectoral challenges, the selection of the challenges and their priority ranking, and numerous considerations of each challenge from a multi-sectoral perspective, as either effective or very effective.
- An average of 60% of those responding to the evaluation survey thought the DigiVoting session captured their thoughts on the manageability and priority of each of the key challenges, whilst 5% of the evaluation survey respondents considered it ineffective or very ineffective.
- Developing criteria upon which to identify challenges was the most difficult task relating to the sectoral activities. Identifying the trade-offs and mal-adaptations associated with each challenge was rated the most difficult multi-sectoral activity, and also the most difficult activity of the workshop.
- None of the sectoral activities were considered impossible. Two of the multi-sectoral activities were considered impossible by some participants, namely the task of identifying trade-offs and mal-adaptations associated with each challenge, and R&D foci needing to be addressed for each challenge.
- Half of those responding to the evaluation survey referred to the pre-workshop surveys when considering possible adaptation challenges for Australia, with some participants using the pre-workshop challenges in their own selection of challenges.
- Nearly half of those responding to the evaluation survey considered that they would be very likely or likely to draw upon the activities and/or results of the workshop to inform their future decision-making processes and/or decisions regarding climate change adaptation actions. None of these participants thought that it would be very unlikely that they would draw upon the workshop.

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APPENDIX A

Organisations and sectors represented by the workshop participants. Those classified as 'multi-sectoral' selected more than one sector. Those classified as 'other' did not consider that they aligned to any of the listed sectors.

Organisation	Sector identified with
University of Western Sydney, Australia	Primary industries
Department of Employment, Economic Development and Innovation, Australia	Primary industries
University of Melbourne, Australia	Primary industries
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Primary industries
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Primary industries
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Primary industries
Imperial College London, United Kingdom	Primary industries
Department of Employment, Economic Development and Innovation, Australia	Primary industries
University of Melbourne, Australia	Primary industries
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Marine and terrestrial biodiversity
University of Queensland, Australia	Marine and terrestrial biodiversity
Office of the Chief Scientist, Australia	Marine and terrestrial biodiversity
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Marine and terrestrial biodiversity
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Multi-sectoral
Reef and Rainforest Research Centre, Australia	Multi-sectoral
Natural England, United Kingdom	Marine and terrestrial biodiversity
South African National. Biodiversity Institute, South Africa	Marine and terrestrial biodiversity
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Marine and terrestrial biodiversity
James Cook University, Australia	Marine and terrestrial biodiversity
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Multi-sectoral
World Wildlife Fund, Australia	Multi-sectoral
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Multi-sectoral
Office of the Chief Scientist, Australia	Multi-sectoral
Foundation for Research, Science and Technology, New Zealand	Multi-sectoral
University of Southern Queensland, Australia	Social, economic and institutional dimensions
Griffith University, Australia	Social, economic and institutional dimensions
Arizona State University, United States of America	Social, economic and institutional dimensions
University of Melbourne, Australia	Social, economic and institutional dimensions

Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Social, economic and institutional dimensions
Bushfire Cooperative Research Centre, Australia	Emergency management
London School of Hygiene and Tropical Medicine, United Kingdom	Human health
Carnegie Institution for Science, United States of America	Human health
Bureau of Meteorology, Australia	Multi-sectoral
University of British Columbia, Canada	Multi-sectoral
Munich Re, Australia	Multi-sectoral
University of New South Wales, Australia	Urban environments
Canberra University, Australia	Urban environments
Griffith University, Australia	Water resources and freshwater biodiversity
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Water resources and freshwater biodiversity
Griffith University, Australia	Local and state government
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Local and state government
Gold Coast City Council, Australia	Local and state government
Department of Climate Change and Energy Efficiency, Australia	Multi-sectoral
ANU	Multi-sectoral
Department of Climate Change and Energy Efficiency, Australia	Other
Victoria University, Australia	Other
National Climate Change Adaptation Research Facility, Australia	Other
UK Climate Impacts Programme, United Kingdom	Other
Gosford City Council, Australia	Local and state government
University of Guyana, Guyana	Multi-sectoral
Australian institute of landscape architects, Australia	Multi-sectoral
Australian National University, Australia	Multi-sectoral
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Multi-sectoral
Asia Pacific Network for Global Change Research, Japan	Multi-sectoral
National Climate Change Adaptation Research Facility, Australia	Multi-sectoral
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia	Multi-sectoral
Leeds University, United Kingdom	Multi-sectoral
Université catholique de Louvain, Belgium	Multi-sectoral
Ministry for the Environment, New Zealand	Multi-sectoral
Bureau of Meteorology, Australia	Other

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