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Enabling political legitimacy and conceptual integration for climate change adaptation research within an agricultural bureaucracy: A systemic inquiry

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Abstract: The value of using systems approaches, for situations framed as ‘super wicked’, is examined from the perspective of research managers and stakeholders in a state-based climate change adaptation (CCA) program (CliChAP). Polycentric drivers influencing the development of CCA research pre-2010 in Victoria, Australia are reflected on, using Soft Systems Methodology (SSM) to generate a boundary critique of CCA research as a human activity system. We experienced the complexity of purpose with research practices pulling in different directions, reflected on the appropriateness of agricultural bureaucracies’ historical new public management (NPM) practices, and focused on realigning management theory with emerging demands for adaptation research skills and capability. Our analysis conceptualised CliChAP as a subsystem, generating novelty in a wider system, concerned with socio-ecological co-evolution. Constraining/enabling conditions at the time dealing with political legitimacy and conceptual integration were observed as potential catalysts for innovation in research management towards better handling of uncertainty as a social process using systemic thinking in practice (StiP).

Keywords: wicked problems, research management, boundary critique, science-policy practice, socio-ecological co-evolution

1. Introduction

1.1 Climate change as a ‘super wicked’ science-policy practice issue

The situation of bringing systemic understandings and practices to institutionalised agriculture can be characterized as one with many interdependencies, complexity, uncertainty, controversy and multiple stakeholders (and thus multiple perspectives) – particularly on the nature of change, strategy, future directions and appropriate practices
This is because there are contested, or unsurfaced, epistemological commitments and assumptions and institutional barriers associated with the functioning of contemporary governance organisations, especially those of the state in a Westminster-related public or civil service, i.e., bureaucracy (Giddens, 2009; Ison, 2010; Jiggins, Blackmore, Ison & Röling, 2016). Complex matters of climate change challenge business-as-usual (BAU) thinking and practices within existing models of agricultural bureaucracy, partly because of their inability to deal with uncertainty as a social problem (Aldunce, Handmer, Beilin, & Howden, 2016; Jiggins, 2016).

Concurrent with similar inquiries into the future of agriculture in Australia and elsewhere (Australian Conservation Foundation [ACF], 2008; Land & Water Australia [LWA], 2008; IAASTD, 2008), the Australian Public Service Commission (APSC, 2007) looked at the issue of policy failure in response to long-term, intractable ‘wicked problems’ (Rittel & Webber, 1973) of which climate change, land degradation and river catchment managing can be regarded as examples. The advent of climate change has led some to broaden Rittel and Webber’s (1973) distinctions between wicked and tame problems to include ‘super-wicked problems’ (Levin, Cashore, Bernstein, & Auld, 2012). Later the APSC’s Commissioner Briggs observed that: “governments are facing new policy challenges, such as climate change, water scarcity, Indigenous welfare, and diseases linked strongly to lifestyle, problems which traditional policies and practices do not seem able to address effectively” (2009, Forward, para. 7). These problems are difficult to formulate and resolve as they have multiple causes interacting in complex ways that are not well understood. These authors, along with others who see an imperative within our current human circumstances of acknowledging the complex (Douthwaite, Kuby, & van de Fliert, 2003; Espinosa & Harnden, 2007; Walker, 2008; Roome & Louche, 2015), and choosing apposite situational framings such as ‘wicked’
or ‘super wicked’ (Levin Cashore, Bernstein, & Auld, 2012), also recognise the importance of introducing and institutionalising systems thinking in practice (STiP), though this realisation is not new (Jantsch, 1972; Flood & Ulrich, 1990; Mulgan 1997; Checkland, 1999).

As Collins and Ison (2009) illustrate, engaging with climate change research, and the distinctions between mitigation and adaptation, throw up challenges to how these concepts and their related practices are to be understood. It is one thing to name an agenda for innovation and change; the challenge is to purposefully create new practices and institutional forms that enable action that is transformative in relation to ‘the wicked problem’ or situation of concern (Hall, Sulaiman, Clarke, & Yoganand, 2013; Roome & Louche, 2016; Eppel, 2016). Problems as pervasive and insurmountable as climate change require some internal re-rationalisation that can help improve the performance of actions intended to address the situation (Randles & Laasch, 2016; Puusiten & Lehtimäki, 2016) by becoming sensitive to the systemic effects of planned actions and the systemic consequences of actions already undertaken or built into extant practices and institutions (i.e., norms, or ‘rules of the game’).

1.2 Using Systemic Inquiry to form a “wicked problem” boundary critique

Considerations of climate change are, or will be, pervasive in all that is done in the foreseeable future not just in relation to agriculture; climate change adaptation (CCA) will be of particular concern (Collins & Ison, 2009; Ison, 2010). Systemic inquiry (SI) (Checkland 2002; Ison 2017) is an institutional form as is a project but, unlike a project, SI starts from a condition of admitting uncertainty and rejects the goal-seeking and timeframe imperatives that have come to characterise ‘a project’ (Allan, 2012). Inquiry is deeply embedded in systems scholarship, not just in terms of external observations but in reflection on cognitive (and social) processes of inquiry, For Churchman (1971) “inquiry” was a reflective process
where thinking, doubting and learning were integral to inquiry practices; reflective learning is learning about how we learn and knowing about how we know (Reichelt et al., 2016; Ison, 2010; Hammond, 1996). SI sits within the systems lineage of scholarship associated with inquiry, learning and pragmatism (Churchman 1971; Dewey 1916/2004; Checkland & Poulter 2006). Boundary critique is an approach used within systems scholarship that supports a shared understanding of the activities people are involved in, offering an opportunity to decide what is in and what lies outside of a system of interest or focus (van Bommel, Blackmore, Forster & de Vries, 2016). A SI enables the possibility of revisiting a boundary judgement in the light of new understanding to test prior assumptions used in generating a boundary critique (Checkland & Poulter, 2006, pp. 170-180).

In a climate-change world it is not knowable in advance as to how to make research practice more effective and to develop and employ systems thinking and science capabilities. In such a context SI makes sense. Our rational for designing and testing a SI approach arose from acknowledging uncertainty at the start in relation to how to (i) introduce systems thinking in practice (STiP) into a conservative and complex bureaucracy and (ii) effectively use STiP approaches within CCA research (Ison, 2017a). We also took seriously the claim by Ulrich (1996 p.17) that “we do not need the systems concept at all if we are not interested in handling systems boundaries critically”. Concern about how, and by whom, systems boundaries are formulated is central to boundary critique; as Ulrich and Reynolds (2010) observe “the real value of boundary critique lies in its dialogical use to test other stakeholders reference systems” (p. 272).

The Ministry within which this research was conducted was at the forefront of climate change research in the state of Victoria and Australia, building on and complementing other national
and international efforts. The main programme of concern to the Ministry staff was undertaken from 2006-2010 under the auspices of a state-based CCA program (CliChAP\(^1\)) dealing with future agricultural systems research. In all over $25 million was committed to climate-related research over two years from 2008. CliChAP was designed as a program that would integrate knowledge across divisions and disciplines as a platform for bridging policy and scientific advice for the research and development of CCA.

The primary driver, and thus research question, behind our funding was: how can systems thinking in practice (STiP) be introduced and sustained in the praxis of climate change research within the Ministry? We addressed this question within a broader initiative, endorsed by the Ministry, concerned with the development and application of Systems Thinking and Systemic Science (Figure 1). Our research began when the CliChAP program was coming to the end of its first iteration and a review, prior to the running of a second round, was in prospect. This provided an opportune moment to open up reflection on the program activities and conceptualisations of its practitioners, as a means to improve working in the novel context of CCA research. Responding by means of systemic inquiry acknowledged the uncertainty and complexity of the research setting. It also offered opportunities to introduce new, or alternative framings (Lakoff, 2010) e.g., CCA research as charting a trajectory of socio-ecological co-evolution (Ison, Alexandra and Wallis 2018).

\(^1\) This is not the actual name of the program but the one we use in this paper to discuss a boundary critique whilst endeavoring to protect the identity of participants and the organization. Where appropriate we use pseudonyms for the names of programs and ministries.
In the overall research program, three inquiry strands were initiated. Each sought to elucidate understandings of the extant use of systems approaches within the Ministry: (1) the perspectives of research division managers; (2) this interdepartmental research program dealing with climate change adaptation (CliChAP); and (3) operations of Communities of Practice (CoPs) in the Ministry. The first and third inquiries are reported elsewhere (Figure 2; Iaquinto, Ison & Faggian, 2011; Ison, Blackmore, Collins, Holwell and Iaquinto, 2014). In this second SI strand ethnographic methods of document analysis, semi-structured interviews and participant observation were used to triangulate (Seale, 1999, p. 475\(^2\)) inquiry into CCA

\(^2\) Rather than use triangulation to affirm convergence of evidence typically used in sociological inquiry, Seale applies a concept of triangulation to offer different views to surface a critical engagement with the way a
research using a suite of systems concepts and adapting SSM (see Section 2).

This was not evaluative research (Vieira, O’Dwyer & Schneider, 2016), but an inquiry designed to learn about current circumstances in a way that could help build future STiP capability and systemic innovation in CCA research in the Ministry. The research undertaken can be understood as beginning an ‘experiment’ in systemic, social system design (Metcalf, 2014); it rested on a number of premises:

(i) climate change research is a new form of research practice;
(ii) the domain of climate change, especially CCA, is a situation characterised by uncertainty, complexity and surprise (Ison, Röling, & Watson, 2007);
(iii) the combination of CCA itself and the challenge of realigning policy and practice within extant organisational/institutional configurations is usefully framed as a ‘super wicked problem’ (Levin et al, 2012);
(iii) traditional approaches to research practice, including traditional project management, may have limitations in this domain (e.g., Allan, 2012); and
(iv) STiP may have useful contributions to make to the Ministry’s future climate change research practice (e.g., Wadsworth, 2012; APSC 2007).
**Fig. 2** A conceptual model of the elements of a Systemic Inquiry (SI) undertaken as part of a Ministry and University collaboration addressing opportunities for using systems thinking (this paper deals with inquiry strand two into climate change adaptation (CCA) research)

1.3 Soft systems methodology adapted to systemic inquiry

Soft Systems Methodology (SSM) situates issues of concern within a social and political context to better understand the practical implications of problem framing (Checkland & Scholes 1999). In simple terms SSM is an “organised, flexible” approach to dealing with
problem situations with a perceived need for improvement; to make situations more acceptable and “less full of tensions and unanswered questions” or uncertainty (Checkland & Poulter, 2006, p. 4). The approach of SSM is action oriented. From a management theory perspective it involves the articulating knowledge phase of deliberate learning (Romme et al., 2010). SSM can be used in organisations, by groups or individuals to improve the interactions between those involved in a situation, even though they might be doing different things, to find and articulate an overarching purpose. It branches off from other systems traditions used in the 1950s and 1960s that had less focus on: the everyday contexts of problem situations; the importance of taking actions to address them; and the need for flexibility in approaches to using systems ideas (paraphrased from Checkland & Poulter, 2006, p. 4-6). Using SSM within our SI seemed an apt approach to formulating a boundary critique with our research participants.

This paper is organised in the following way. In section two we explain and justify methods employed as elucidating desirable change through a joint appreciation of the 'system' in focus. We then describe our enactment of SI modelled on i) a nested set of geopolitical discourses in policy documents addressing CCA; ii) a particular enactment of the Ministry’s policy response and research program (CliChAP); and iii) the outcome of our process of engaging participants in SI, responding to three subsidiary research questions (introduced below). In conclusion we explore strategic possibilities for using SI in future CCA research as a situation of socio-ecological co-evolution involving complexity, uncertainty and surprise to articulate a means for supporting the emergence of innovations in research management practice.

2. Methodology: preparing a systemic inquiry
An initial phase of SI began in September 2009 and was drawn to a close in October 2010. We designed the SI so as to generate data and insights from the first iteration of the CliChAP research program and in relation to anticipated development of future CCA research; our design involved other government researchers beyond our Ministry sponsor. It was also designed in relation to how to introduce and build STiP as an organisational capability. Our intention was to develop an awareness of how members of the organisation participated in organisational routines and how they might be supported towards a better appreciation of CCA research practice using systems approaches.

2.1 Elucidating systemic appreciations of a ‘super wicked problem’

Methodologically we framed CCA research as a human activity system pragmatically engaged in inquiry. We used ethnographic methods to explore influential discourses of CCA research nesting the activities of CliChAP in a wider policy context, conceptualisations of CCA research as revealed through managers’ and stakeholders perspectives of CliChAP, and local organisational culture of activities related to CCA research and policy development. Data collected for this inquiry strand is summarised in Table 1 (see also Figure 2). The rationale for collecting these data relates to choices made in our adaptation of SSM in which we temporarily suspended the two streams model of SSM to more deeply explore the processes involved in articulating relevant systems of a super wicked problem (see section 2.3). Subsidiary questions were formulated to capture three elements of cultural analysis dealing with the ‘problem’, the ‘social’ and the ‘political’ situation (Checkland & Scholes, 1999) as:

1. How do participants construct the problem of climate change, what is the context in which they are motivated to respond to climate change?

2. How is climate change research rewarded, what are the significant roles for climate
change researchers?

3. How can we analyse the relational dynamics as evident in the types of influence different interests and groups have over climate change research?

Table 1: Set of data collected for the inquiry strand through documents, interviews and participant observations

<table>
<thead>
<tr>
<th>Documents</th>
<th>Wider discourse</th>
<th>Strategic response</th>
<th>Internal ministry</th>
<th>External ministry</th>
<th>Non-government</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research division</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other division</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>1*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policy &amp; Strategy</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meetings</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Conference</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Training program</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Conversations</td>
<td>28</td>
<td>10</td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

*Interview conducted with two participants

The situation was approached using methods of document analysis, semi-structured interviews and participant observations to ground inquiry in the actual practices and perspectives of our participants (Hammersley & Atkinson, 1995). Three documents were selected for review, as recommended by our Ministry collaborators, to help locate a polycentric ‘context’ and sense of direction for CCA research nested within international,
national and state discourses of climate change:

(i) Intergovernmental Panel on Climate Change [IPCC] Fourth Assessment Report Summary for Policy Makers (IPCC, 2007) referred to from here on as IPCC;

(ii) Land and Water Australia’s National Climate Change Research Strategy for Primary Industries (LWA, 2008) referred to as CCRSPI; and

(iii) Victorian Government Climate Change Framework Green Paper (Victorian Government [VG], 2009b) referred to as CCFGP.

Within this nesting of CCA research policy drivers we also examined three relevant ministerial strategies (one for future primary production systems and two iterations of an investment strategy for primary production research) as ‘responses’ to this wider context shaping the development of CliChAP. Thirteen participants (two in one interview), were purposefully selected with our Ministry research collaborators to represent internal and external views of CCA research practice as it took place over a four year term of CliChAP. Participants’ interviews captured six internal division (ID), three external division (ED) but internal Ministry, and three external Ministry (EM) perspectives to facilitate a multi-focal view of the situation. Participant observations were recorded whilst the first author was hosted by the division as a collaborative researcher, engaging with University and Ministry research staff on a weekly basis throughout the research. Observations included reflective journaling of incidental conversations as well as attending meetings and events within the Ministry and other local policy-research interactions such as workshops and conferences.

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3 We acknowledge the choices made for this nesting of policy drivers. Another significant international document which potentially could have shaped CCA research in Australia is the 2008 Synthesis Report of the International Assessment of Agricultural Knowledge, Science and Technology for Development – the outcome of an international process in which Australia participated (although it did not endorse the final report).

4 For purposes of anonymity we do not reference these strategies in this paper.

5 We treat these two participants as one interview as their perspectives were similar, views expressed during interview reinforced each other and there was no attempt made by either participant to contradict or challenge each other.
occurring in Melbourne and other parts of Victoria.

2.2 Appreciating different conceptual models

In situations best understood as ‘super wicked’ it is difficult to appreciate and articulate a stabilised ‘real situation’; in this case so much was in an uncertain state including divergent leadership perspectives on whether or not human-induced climate change was ‘real’.

Conceptual models presented during interviews and other interactions were used to reveal how various actors understood their situation. For the purpose of this study a conceptual model is a cognitive framework that includes representations of tangible things or abstract ideas and relationships between them. We employed conceptual models of our own and sought to make apparent the conceptual models held by different participants as processes designed to have an effect on the real world situation. We sought to explore how conceptual models were revealing or concealing different aspects of the situation. For example, climate change was expected to impact on plant physiology through increasing/decreasing parameters of temperature, carbon dioxide and water. By experimenting with these parameters better knowledge of plant responses to change could assist in understanding how to maintain or improve food qualities and productivity into the future.

2.3 Adapting Checkland and Scholes’ two-streams approach: Exploring ‘relevant systems’

Checkland and Scholes (1999) two streams approach to using SSM (Figure 3A) was adapted as a way of moving towards a structured debate with our participants about what were

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6 Conceptual model is use here as distinct from mental model used by Rook and Watson (2017), as conceptual model was the main construct of SSM used to conceive of ‘relevant systems’. Mental models are more closely aligned with the work that people do in the ways they interact with their work environments. Conceptual models abstract away from work to articulate a purpose for activities that may differ from the actual activities. We address this tension by engaging with theory-in-use (mental models) versus espoused theory (conceptual models).
perceived to be relevant systems in real world situations dealing with CCA. Figure 3A illustrates our adaptation of the two streams model of a human activity system involving a real world situation and a group of people intending to improve the situation. As the would-be improvers, our research team engaged with the real world situation in the Ministry: 1) as a culture involving a problem situation, a social and a political context in one stream and 2) through a set of conceptual models of the real world situation generating ‘relevant systems’, or epistemological devices to understand and effect change, in another logic-based stream (Figure 3A). We did not know how relevant systems would be articulated under the set of governance challenges presented and so needed to explore this with our participants using ethnographic methods as represented in Figure 3B.

Furthermore, we were interested in what documents and people claimed to be important compared with what people were actually doing as a basis for framing future iterations of CliChAP. Our adaptation of SSM drew upon Argyris and Schön’s (1974) contrast of ‘espoused theory’ versus ‘theory-in-use’ to support the development of a boundary critique for our system of interest, i.e., a climate change researching system (Figure 3B) with a set of relevant subsystems articulating adaptation.
A] An adaptation of Checkland and Scholes (1999) two-streams approach through which our systemic inquiry (SI) was applied, reflecting Argyris and Schon’s (1974) ‘espoused theory’ and ‘theory-in-use’ for making a boundary critique.

B] Conceptual model of our second systemic inquiry strand using ethnographic methods of document analysis, semi-structured interview and participants observations to interpret differences between conceptual models and real world situations.

Fig. 3 An adaptation of the two stream approach to Soft Systems Methodology (SSM)
enacted as a Systemic Inquiry (SI) for exploring cultural aspects of the situation including appreciation of espoused theory and theory-in-use (A), using ethnographic methods to interpret difference between conceptual models expressed by participants and as perceived by us (with our first author as the main observer, acting and checking interpretations with either of the other authors), and real world situations as perceived by us (B)

2.4 Constructing root definitions: a system to do what?

Root definitions (RDs) provide a basis for examining the underlying purpose, process and outcomes that shape a system of human activity/activities (Checkland & Poulter, 2006). In this case they provided a means of exploring differences in what people do in CCA research that could then be used to inform a discussion about the purpose of CCA research and how different activities might be better aligned. A RD is used in SSM as a way of describing a possible, or potential, or implicit system of interest (Checkland & Poulter, 2006, p. 38-47). Creating a RD, or many RDs is something that can be done based on the outcomes of any structured engagement with a situation of concern, and is a way to make explicit one’s thinking or the thinking of others in a systemic form. A root definition gives additional context to an activity when participants are asked, or research data are used, to describe a system to do something (P = what) by some means (Q = how) in order to achieve a certain outcome (R = why). Constructing root definitions is a technique that can be used to facilitate exchanges between diverse and possibly competing perspectives thus gaining accommodations between those with different interests.

2.5 Engaging participants in Systemic Inquiry through interviews

Interview participants (see Table 1) were asked ten interview questions that elicited ‘descriptive’ and ‘reflective’ responses (Figure 4). Our reflection on CliChAP with
participants was intended to open up reflexive moments to facilitate innovative thinking and realise improvement in research management practice suited to the context in which researchers and stakeholders were motivated to respond to climate change.

Fig. 4 Two types of question, descriptive and reflective, asked during interview

Responses to these questions were explored for themes using Corbin and Strauss’s (2008) methods of constant comparison between categories identified and people’s actual interview comments. Questions one and two were used to generate descriptive and reflective thinking about participants’ stakeholding and role and how that may or may not have led to credible and relevant knowledge on climate change. The analysis of these two questions was used to create a set of RDs of possible CCA research systems. Questions three to eight were analysed to both describe and reflect on the ‘problem’, the ‘social’ and the ‘political’ situation drawing out themes that could then also be related to the documents reviewed and participant
observations. The final two of our interview questions, not dealt with here, are being taken up in another paper.

3. Results of phase one: Enacting a systemic inquiry

We sought to understand, with our co-researchers, how systems thinking in practice (STiP) existed within, or could be introduced and sustained through, the praxis of climate change research within the Ministry. The contextual underpinnings for this were the global and locally networked policy setting, the emergence of the programme through a whole-of-government approach to climate change, and articulations of our participants’ activities as root definitions. Together these formed a multi-level lens for us to navigate as systemic inquirers (Figure 3B).

3.1 Geopolitically nested documents: a 'glocally' networked policy setting

The main systemic drivers as to what was being enacted in CCA research were elucidated from the sample of three documents (Table 1 and Section 2.1). While global responsibility was promulgated by the IPCC (e.g., changes in agricultural practice, policies and institutions to facilitate change, and appreciating constraints and opportunities), there were challenges in national and state implementation of this, with the uncertainty of local climate change impacts and effective policy responses, suggesting the need for an opening of engagement where issues could be freely discussed and institutions developed in an environment of transparency and trust. At a national level in Australia, CCRSPI recognised the need for innovative policy responses and sought an understanding of the interrelationships between the actions of researchers, policy makers and producers particularly around resource management practices. The Victoria’s CCFGP sought greater awareness of the impacts of actions (of federal and other states) on state economic and resource futures to enable
contingency or flexibility in policy responses.

3.2 CliChAP’s emergence through a whole-of-government approach to CCA

CliChAP was an interdisciplinary interdepartmental program implemented under the Bracks Premiership in Victoria (1996-2007). It was an ambitious interdepartmental approach to meet the, at times, competing demands of land, water and biodiversity conservation and production needs as well as internally competing land and water uses under conditions of climate change. CliChAP presented a range of biological, social, policy, information technology and spatial science researchers within the division and some of its intra- and inter-departmental stakeholdings with a complex and difficult set of issues. It was a situation that required greater deliberation than was typically encountered in research management practice with higher levels of uncertainty making it difficult to decide on appropriate topics/ cause-effect relations or questions to explore that would benefit future development of agriculture amidst other primary industries and competing resource needs/ uses. Furthermore, the political situation when CliChAP entered its final year had changed significantly from the time of its implementation with leadership changes in federal and state governments that brought discursive and policy shifts in climate action.

3.3 Incidental conversations and participant observations

As a result of engagements over twelve months two main thematic areas of interest emerged for exploring the culture and practice of CCA research: i) gaining political legitimacy for research within the organisation; and ii) constrained conceptual integration of diverse program activities. It was concluded that these two issues held promise for personal reflection by researchers in a subsequent round of engagement, e.g., through systemic co-inquiry. Our experiences suggested that exploring these two areas might enable greater institutional
reflexivity by triggering ways of working more closely between policy, industry and community stakeholders (Bawden, 2005; Sposito, Faggian & Romeijn, 2013); or at least a discussion of personal motivations in relation to the motivations of others both inside and outside the research division (Barnett & Gregorowski, 2013; Reichelt et al., 2016). For helping realise this, we present our participants’ descriptions and reflections on their role and contribution in CCA research (interview questions one and two) through which we felt participants were enacting political and social legitimacy of their activities (Figure 5).

3.4 Participants ‘root definitions’: A system to do what, how and why?

The set of RDs shown in Figure 5 have been generated by us from analysis of content from interview questions one and two (Figure 4) seeking a description of what participants do and their main stakeholders as well as reflection on how they are able to make a contribution to climate change knowledge. Our purpose here was to surface and capture different accounts of the systems people were working with, how participants conceptualised their work practices in relation to climate change as a means to bring together and articulate areas of awareness in their practice that may not otherwise have been expressed. Each RD depicts what the participants suggest as the dominant 'systems of interest' that the particular individual engaged with in research activities. Our formulation of participants’ RDs reveals how research was pulling in different directions, from increasing capacity to act under conditions of uncertainty to improving the future quality of food and farm productivity. Others were concerned with appreciating policy and the effects it has as well understanding climate change impacts and developing strategic options.
Fig. 5 Constructed root definitions (RDs) of participants’ ‘system of interest’ in CCA research based on responses to interview questions one and two (any sequence across the three columns should be read as ‘a system to do P (what) by Q (how) because of R (why)’)

A sense of coherency between such disparate areas of inquiry that could contribute to a whole
of government approach to CCA was yet to emerge from the collective experience of research managers and stakeholders. Participants RDs showed a high degree of variability with uncertainty (as opposed to predictability) playing a clear role in defining the purpose of research from different perspectives. Issues of reflecting and adapting policy according to the effects of actions taken, and enabling the generation of efficiencies under resource constraints were thought of as new means for managing uncertainty. Feedback on knowledge applications, such as hearing the concerns of farmers or encouraging awareness of climate impacts; and realising opportunities to innovate including the development of strategic options or new practices or technologies also seemed important, yet there were limitations in terms of project management serving the intended goals or possible actions of stakeholders.

Our inquiry revealed major limitations in the enactment and structuring of project management within the Ministry; this constrained acting systemically and outside project boundaries or working within silos. While areas of innovation had been sought as part of a cycle for project framing, the ability to respond to new insights or understanding could not be captured by a project-based format. For example, there was no inbuilt adaptability and transferral of resources from one area to another. Furthermore, people being tied to projects left them with little flexibility to work with others or realise key shifts in thinking as a result of engaging different stakeholders.

4. Developing a cultural analysis: Moving between scales

Participants’ interview responses to questions three to eight (Figure 4) are discussed within an understanding of the wider context and local culture generated through our triangulated ethnographic approach (Figure 3B). We summarise the diversity of responses and offer a systemic appreciation through comparison of espoused and in use theories of adaptation. The
concluding discussion points to how future research and research management practice could benefit from using STiP to structure problem situation discussions and deal with issues as they arise in processes of inquiry.

4.1 Looking from the local situation on the wider context

Figure 6 summarises interviewee responses, revealing the diversity in participants’ descriptive and reflective perspectives of the problem, the social and the political situation. Responses are discussed to consider how practices of research management enabled and constrained opportunities for: i) realising climate impacts; ii) opening up inquiry and iii) creating dialogue for innovation.
Fig. 6 Summary of descriptive and reflective responses pertaining to three aspects of cultural analysis (Figure 3A) conceptualised by the SSM two-stream approach.

Interview responses provided a basis for exploring participants’ activities (theories in use) or what Norman (1983) refers to as mental models in reflection of various conceptual models of CCA research (espoused theories) (Argyris & Schön, 1974). Attention was given to capturing themes that represented the breadth of participants’ perspectives, and not just areas of commonality, as summarised in Figure 6. Some themes capture responses from participants across Ministries (Ext-M), whilst others were shared by participants within the Ministry but
external to the division (Ext-D) or across the division (Int-D), although this cannot be assumed to capture all that participants thought about research and practice. Stakeholders and managers perspectives are now discussed in relation to the documents reviewed and participant observations to respond to the three subsidiary research questions (see Section 2 above) for the SSM cultural analysis stream. Specifically we address the context in which participants were motivated to respond to climate change research, the significant roles played by CCA research and the relational influences of different groups and interests on research activities. Key tensions are highlighted between documents and practice as well as between participants’ perspectives.

4.2 Construction of climate change: a context for motivating response

The IPCC Synthesis Report for Policy Makers posed the threat of “unmitigated climate change” as likely to “exceed the capacity of natural, managed and human systems to adapt” (IPPC, 2007, p. 65). Participants reinforced this problem framing as not only related to the ability to retain production and secure future food supply for the economic and social benefit of Victorians by responding to the “reduced ability to produce food” (Int-D003) and water as the “one of the biggest impacts” (Ext-D010), which had already driven change in practice where farmers “had no choice” (Ext-D009) but included issues not traditionally addressed by agricultural bureaucracies such as mental health and community well-being. Concerns were expressed about an “increasing population” with the risk of “wars fought over water and food” (Int-D003) as well as dealing with “a lot of unknowns [and] uncertainties” making it “difficult to stay mentally healthy… to stay in business” (Int-D011). Others expressed a sense of social upheaval through “coastal movement of all agriculture” (Ext-D001) in addition to the “extreme heat and the threat pose[d] to health and infrastructure” (Ext-M002) embedding

7 Quotations included in the analysis are from interviews conducted between 23 Sep 2009 and 14 May 2010)
a concern about community stability. However, these complexities were difficult to convey in an environment where the ‘thirty second elevator pitch’ - a metaphor for having limited access to decision makers - was observed as the principle means of gaining influence within the Ministry. From this perspective the details of research activities collapsed into, at times, over-simplified explanations, leaving limited appreciation of the context in which knowledge was generated.

Such simplifications of climate change research were contrary to dealing with the threat of climate uncertainty and less predictability, noted by participants within and external to the division as well as in other Ministries. For one external stakeholder the significance of “extreme weather events” (Ext-M002) and their “frequency and extremity” (Ext-M002) was realising “a sense of unpredictability” (Ext-M008), which contrasted with “some good news stories” (Int-D003). An internal stakeholder recognised that “plants grow faster and bigger under high CO₂” (Int-D003) along with “opportunities for carbon sequestration” resulting in a “better understand the soil profile” (Ext-D012).

Greater risk and uncertainty expressed in the green paper CCFGP (VG, 2009b) indicated a dynamic decision making environment reflected as the contingency of state level choices to be made in relation to the effects of national policy (pp. 7-8). Some participants’ descriptions reinforced this concern of climate change as a threat to competitiveness and business sustainability needing national-level leadership. For one, climate change “has provided a lot of funding” where “we’ve [government] swung the pendulum that way” (Int-M004) to which there was now an emerging “gap in terms of R&D funding” which was perceived as “an internal type of threat” (Int-M004). Another noted that “changes are subtle” and experience “may not realise the full impacts” which underlined the problem that “private industry tends
to react” (Int-D006) rather than anticipate future risks. However, the LWA document expressed concerns about science and practice with regard to primary industries coping with competition over land and water resources and their use continuing into the future (2008, p. 16-20). Thus sustainability is conceived not just as maintaining presence in a market place but better use of resources that does not diminish ones’ ability to adapt (Sposito, Faggian & Harmeijn, 2013; Bosomworth et al., 2017).

Participants’ responses to how they were conceptualising climate change research reflected an opportunity for better understanding of environmental interactions and the socio-economic consequences of climate change. Internal Ministry participants also suggested that addressing the problem of climate change was improving capacity for sharing responsibility and that they themselves were contributing to building local relevance of policy and science. An internal stakeholder was motivated by “helping general understanding” and “helping the literacy of our stakeholders” to be able to contextualise and interpret “main climatic patterns” (Ext-D012). However it was important for another internal stakeholder that farmers were “drawing on their own experience” as a resource to “try and make sense of the world” (Ext-D010). Non-division participants also indicated that they were facilitating new research relationships. However, following an initial program workshop offering constructive dialogue on cross-cutting issues in CliChAP, researchers were observed to fall back into their ‘silos’ or ‘comfort zones’. There was a sense that policy making could be made more robust by considering the “solution-making” as something “happening at the local and community and regional level” (Ext-D009). Yet there was not much evidence of that where research was “too centralised at the minute” (Ext-D009). Researchers and stakeholders seemed to be inspired by early dialogue but opportunities were not followed up. This suggests a need to explore narratives of climate change research practice to realise how institutional transformation was
sidelined throughout the inquiry process. One stakeholder was motivated to generate a “better understanding of some of the potential opportunities” which could be supported by “visualisation and modelling techniques” as a means “to understand what the future might look like” (Ext-D012). From this perspective research was important to “start having a practical discussion around adaptation and management strategies” (Ext-D012). However, other institutional practices of failing to influence political action reinforced a concern expressed about the threat of reactionary rather than anticipatory politics. Such views indicated an inadequate consideration of the nature and scale of climate change impacts for realising appropriate policy responses.

In 2007 the primary industries strategy CCRSPI\(^8\) encouraged scientists and policy stakeholders to engage with issues of climate change impact and adaptation at the national level. However during the implementation of CliChAP, in the years following, the continuation of earlier dialogue seemed difficult within the state Ministry. Initially a shift in participants’ perspectives away from tendencies to isolate disciplinary areas within agricultural bureaucracies (including scientific research from policy advice) was apparent. However, efforts of integration were poorly maintained and may even have been constrained by institutional imperatives associated with project management to stay on task and therefore limit opportunities for further conversations. Against this confusion there was concern that researchers “can only try and anticipate and predict” while “there’s a lot of uncertainty” and in hindsight their “messages aren’t convincing or don’t eventuate” (Int-D011). Another added the importance of “nailing underpinning assumption” such that they could be “constantly questioned and debated” (Ext-D007). This was also suggested by an external stakeholder in

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\(^8\) Land and Water Australia, the organization responsible for the development of the climate change research strategy for primary industries (CCRSPI) was disbanded in the year following this publication in a Federal government restructure of land and water research.
reference to the context as “evolving” with a need to understand “biophysical changes” and “how they play out in natural and built environments” (Ext-M002). Some opportunities were noted for using locally embedded inquiry approaches, which supported the development of new research relationships but not from within the division. Opportunities that contextualised scientific and political dimensions of climate change impacts and adaptations were not as influential as they could have been in shaping research outcomes.

4.3 Rewarding climate change research: significant roles for CCA research

The IPCC emphasised the importance of sustainable development and how adaptation is now unavoidable, as evidenced by effects that are already being witnessed in hotter, drier conditions and more extreme weather events. In spite of differences in stakeholders’ perspectives on whether or not the climate was changing or just displaying more variability, participants within the Ministry suggested that, socially, they were making a difference by helping to avert food insecurity. One of the research managers recognised the importance of CCA research against the “future of the world's sustainability” governed by “food and access to natural resources” (Ext-D007) as a matter of global priority. For another CCA translated as the need to improve productivity, reduce resource use and reduce input costs as an “age old story … [of] being able to produce more with less” (Ext-M002). However as juxtaposed with another perspective change in climate “still has to interact with all these other uncertainties”, which also challenged whether adaptation had made farmers “more resilient to other shocks” (Ext-D009). Nevertheless, observations indicated there was little time for explaining issues or reflecting on more complex phenomena with state policy makers (outside of those drawn into some parts of the CliChAP program and research process).

Participants indicated that working more closely with farming operations and local
organisations was leading to a higher level of appreciation for climate change impacts. Yet for one there was little investment in research that “finds” and “connects” people in a way that facilitates engagement about adaptation that could lead to innovations in agriculture and framing practices (Ext-M005). On the other hand an internal Ministry participant noted farmers are changing their practice “as a result of 13 years of low rainfall” in the sense that “their behaviour is as if climate change is real” (Ext-M002) and yet there was little opportunity to focus on future risks. Some farmers were seen to have increased “their productivity under climate variability” (Ext-M002), suggesting that some adaptive actions had been realised. Our observations noted climate ‘variability’ and ‘challenges’ as replacing the stronger language of ‘change’ in the Ministry's description of research outcomes. It is possible that such language shifts were to avoid rather than challenge the political inconsistency around commitments to climate science witnessed in both state and federal governments in Australia at the time. This contrasted with an emphasis in the CCFGP on understanding designs for, and the effects of, an emissions trading scheme (ETS) as a significant policy response that remained unresolved and that was generating policy uncertainty (VG, 2009b, pp. 11-13).

On the other hand participants from within the division and the Ministry felt they were helping stakeholders in making adjustments to new environments by providing the scientific evidence that could support adaptations of current agricultural systems. For one research had a role to perform in “removing the impediment” which required finding where “there’s a block that government has control over” (Ext-D001). Another felt that research had to be designed to “make sure it helps people respond in their own way” where there are differences in “all different nooks and crannies” (Ext-D009) of Victoria. This may mean a need to “change the business structure” or that we “might have to re-adjust how we finance this” and
think about “farms spread across climate zones” (Ext-D009). Participants, notably from within the division, indicated that research was focusing on how actions in the present would impact future choices, opening up concern about future opportunity that could lead to/ inhibit innovation. Research can add value where stakeholders “do want to know what the future will look like” which requires a kind of “tactical management strategy for the here and now” (Ext-D004); and then “how do you link change now … to what’s going to happen in the future” (Ext-D004), where farmers can “have a sustainable business into the future” (Int-D003). However from an internal division perspective it was “also for the community for other reasons, for social and economic reasons” because “if we don’t adapt, and adapt really quickly, there’ll be real food shortages in the future” (Int-D003).

In CCRSPI greater collaboration between researchers and decision makers was seen as part of a program of social activity including workshops, advocacy and championship to enable changes of practice. However the impetus of CCRSPI was not maintained at the national level as it was one of the last documents produced prior to Land and Water Australia being decommissioned in 2009. Nevertheless, participants external to the division felt that research was developing new techniques for engaging local and policy stakeholders in climate change adaptation as a positive construction of interactions between researchers and communities. Research was valued for “being able to bring together quite a number of people” as those who “had a common interest in climate change” offering a “diversity of perspectives” and “getting to different sections of society” (Ext-M005). However this required a more “participatory research” approach “where we open up the research on climate change and we let the maximum amount of people participate” (Ext-M005). Whilst there was some depth of research there was very little perceived “vertical and horizontal integration of the research effort” directed at “identifying priority” and “cornerstone capacities” (Ext-M005) as a means
for better articulation of policy that can result in long term effective action. It seems there were some struggles for realising a focus on strengthening the partnership between research and industry to encourage cross-sectoral investment expressed in CCSRPI.

Some participants reflected on key stakeholders within industry and the Ministry as continuing to value the contribution of research to production efficiencies. External stakeholders expressed a view of “visualisation techniques” that were more successfully “engaging people across multiple fences” who “feel connected to the issues in different ways” (Ext-M005). This contrasted with an internal stakeholder who found that in reality the Ministry “only spend about 10% on communication” (Ext-D009). Without having this kind of outreach effort “too much of the focus and discussion at the moment has been done at an industry level” with the department “caught up with co-investment” (Ext-D009). Yet participants also reflected on how stakeholders were valuing an understanding of the complexity of the situation and developing capacity for appreciating the conditions through which innovation could be optimised. These evaluations included areas of managing risk and building resilience to market and natural environment dynamics. However, this was concerning from the perspective that “people will choose futures that aren’t right for some of those industries” and their interests are not necessarily being served where “government could be captured” (Ext-D009) by its industry-based stakeholders.

A more critical view of how research currently functions was an external perspective that recognised “some of the risks and opportunities are within the policy and within communities” that could “help drive some of the questions that research might focus on” (Ext-M008) and new areas of resourcing. However, amongst the range of program areas observed, only one initiative in which sharing resources between researchers working in
different areas was developed (albeit under initial resistance from project management) to acquire new research capability, in this case, for meeting a gap in regional economics expertise. Furthermore there was concern where government has “got all these single focus polices and regulations” and “the only person who really knows how they work in totality at the farm level is the farmer” (Ext-M002). The implications of all these “different policy activities intercepting at their property” influenced the perspective of farmers who “preferred us to come with a joined-up government” (Ext-M002).

Traditionally in agricultural bureaucracy research there has been a tendency to maintain disciplinary boundaries and prevent collaboration across divisions and departments. Keeping research focused within disciplines possibly prevents deviation from what has historically been framed as a transactional approach to managing research timelines and milestone delivery (c.f., Eppel, 2016), with research serving the purpose of filling gaps within disciplines. However, limited opportunities to innovate across program areas also left those involved in writing the final CliChAP report with the difficult challenge of bringing disparate program modules into a coherent whole. An internal investment conference provided a vehicle for integration but only insofar as people were able to witness what others were doing, and this anyhow occurred at the completion of projects, rather than at a point in their development that might influence or change the outcomes.

Furthermore, a focus on production efficiencies related to increasing profit margins seemed to circumvent a view that there were emerging environmental constraints on production such as resource competition. One of the manager’s felt that they supported decision makers by “looking at the probability of getting a yield with different management practices” so that they could “see the penalty of going for one option over another” (Int-D011). Yet another
more hidden perspective of valuing research was the change that research investments made to the type of inquiry conducted. As one manager noted “breeding programs aren’t in government areas now” and so you “tend not to get the diversification because it’s too expensive to do that research” (Int-D011). Accordingly CCA research worked in concert with these types of investment decisions by driving questions on how plants are “going to perform over the landscape” (Int-D011). For this manager, working across disciplines was valued, “again with that modelling” it is “important for us to know … if we go down this track … are they going to fall over in 20 years’ time when the climate is different” (Int-D011).

The Climate Change Research Strategy for Primary Industries (CCRSPI) reinforced the IPCC concern for developing innovative policy approaches to managing natural resources as requiring new approaches to sustaining agricultural production amidst resource constraints (LWA, 2008, p. 16). In spite of limitations in developing conceptual integration, participants outside of the division saw research valued through processes of facilitating a shared vision for investment. An internal stakeholder illustrated the issue as people “tend to want to hang around in like-minded groups” and in order to stimulate innovation “some people that need to hook up that have got a similar vision” (Ext-D009) have to be found. Yet the challenge for research is how “you make those connections” where “people who are ready to go are a bit isolated” (Ext-D009). Others internal to the division and from an external Ministry noted value in developing a dynamic modelling capability that accommodated interactions between areas of sociocultural and biophysical scientific inquiry. However for one of the external stakeholders there was “nothing universal” (Ext-M008) being applied to link across disciplines. There was “great linking up between the global climate modelling type people and water industry” albeit in the areas of “science-based and reductionist science type of thing” (Ext-M008). However, “linkage back to things like policy or some of the social
resilience” (Ext-M008) was not quite as well integrated. The practice of linking across disciplines to open up new knowledge required of more pragmatically focused CCA research contrasted with the tendency of research management to look at filling gaps in disciplinary knowledge.

4.4 Examining the relational dynamics: influence of different interests and groups

The IPCC (2007) acknowledged uncertainty in: i) the details of how impacts will be felt in different locations; as well as ii) the effectiveness of different policy responses. However there was difficulty, in the changing Australian political environment, for researchers to move into a framing of climate change as underlying the design of research activities. Many existing projects not necessarily related to climate change impacts were ‘re-badge’ to fit within the climate change adaptation program. Internal Ministry participants responded to the re-badgeing of existing projects with mixed feelings, on the one hand enabling the continuation of previously invested work, e.g., increasing efficiencies in production and integration of production and conservation methods for the marginal lands of upper catchments, and on the other as preventing response to emergent research needs. In many respects managing research capability resulted in a tendency to support what was internally valued as existing research capability in the organisation. On the other hand one of the research managers noted that there were “synergies across industries and across divisions” and that the Ministry “probably don’t use it as well as we should” (Ext-D004).

The importance of developing risk management approaches and information technologies was emphasised by CCRSPI for acting within a wider awareness of (social and natural) environmental constraints (LWA, 2008, pp. 24-25). Participants indicated that research was being contextualised by engaging stakeholders directly in research activities and that CCA
research was contributing positively to an understanding of biophysical interactions of agriculture with its ecological environment. There were positive views of engaging farmers and others in farming communities with climate science as “fast tracking climate change adaptation” (Ext-D009). This represented a picture in which action was “happening at that context locally” and reflected an approach of “brilliant results of that participatory action research” (Ext-D009). Others also supported this perspective of connecting research to local contexts to “enable people to see and touch and talk about what is going on” (Int-M012) for appreciating the meaning of CCA. Such understandings were likely to influence policy directions insofar as people felt empowered by the research. Furthermore there was a range of ways research was being recognised by external stakeholders including a “more narrative research” that focuses on “the way people live and work and do things” (Ext-M005). However a more integrated “trans-disciplinary research is something that will emerge” and “it will not just be academic concept any longer” (Ext-M005) with a greater community capacity to engage in research.

The CCFGP expressed a desire to set “strong, clear goals in responding to climate change”, in “contributing to national efforts to reduce emissions” and “realising the [s]late’s ambitions for managing and adapting to the impacts of climate change” (VG, 2009b, p. 3). Participants recognised the importance of using evidence to change behaviour and of understanding the political implications of forecasting, e.g., where future scenarios produced new political challenges that could influence policy directions. There was also a view of research in “understanding how crops grow in different environments” (Ext-D011). Such interactions at the farm level were recognised as “distributed intelligence” which “localise the thinking about the particular problems today” in which understanding the interactions also “localise the responsibility” (Ext-M005). There was concern expressed here and elsewhere that
research was “addressing subsets of the complete” rather than opening up inquiry to “share it in ways that are going to be interpretable by different stakeholders” (Ext-M005). However the change in political direction of climate policy by end of the first iteration of CliChAP left this possibility unrealised and, after some time, earlier relationship developments undertaken to share the approaches and findings in other regions were not taken up within the Ministry.

Examples of planned adaptation in the agricultural sector envisaged by the IPCC covered: a) strategies such as the adjustment of planting dates and improved land management; b) reform of institutions, financial incentives and capacity building; and c) technological and financial constraints including access to new varieties, changes in growing seasons and revenues from new products (2007, p. 57). Such a suite of adaptation activities implicated a coordinated approach where adjustments in one area could support changes in another rather than lead to contradictory efforts. However, participant observations indicated a degree of ‘scepticism’ amongst researchers about working with other disciplines or areas of research, in addition to a lack of trust or confidence in engaging with areas outside of researchers’ expertise, which seemed to hamper more open collaboration. Nevertheless participants reflected on the linking of research activity through informal and formal networks beyond the organisation’s traditional research stakeholders including engagement of regional branches of government, other Ministries, service industries and community groups and recognised CCA research as contributing to the formation of new relationships. One of the internal managers saw the value of “commission work in systems science to enable workshops” to open up discussion of issues and “explaining it in different ways” (Int-D006). Another view was generated that “if you’ve got a good framework” and “everybody can relate to that” it can successfully eliminate a lot of “destructive competition and wasting of resources actually evaporates” (Ext-D007).
In reflection, for one of the research managers it was thought that the Ministry “haven’t got the various wires” or “best estimate” on how all that knowledge can be drawn together (Ext-D007). It was still seen as a “very conceptual, fuzzy model” where “we haven’t invested the appropriate amount of time in doing it” (Ext-D007). Some participants saw the importance of rewarding feedback and collaboration for making better links with new stakeholders as well as efforts of connecting research across different disciplines, concepts and models of adaptation. From this perspective the management of research could be supported by “getting the right people together with the right process” and recognising the importance of “revisits in eighteen months’ or two years’ time” where “knowledge and understanding has advanced” (Ext-D007). The complexity of the issues was still recognised as beyond conceptual research where “bringing that understanding together” that has “so many interactions and feedbacks” is something that was difficult get “on top of what the system looks like” (Ext-D007).

The CCRSPI recommended additional areas for investment to drive innovative approaches to resource management and policy development including closer engagement with the users of climate information to promote involvement in the processes of decision-making (LWA, 2008, p. 27). In this national strategy, dialogue was recognised as a valuable means to ensure activities and decisions of researchers, policy makers and primary producers were well aligned and interrelationships between resource management practices identified (LWA, 2008, p, 32). One internal Ministry view also realised that you “could end up with some conflicting outcomes” which are not realised in the process of research design but “when you draw it up and apply it at the point of impact” (Int-D004). Some of the strategies used to accommodate these issue of practical implications of research for stakeholder included “specifically put extension people in beside our researchers to look at how” the research
interacted with what they were actually doing (Int-D006). These experiences led managers to the perspective that “you need that involvement of your [end] users and your intermediate users in the research” to “understand that it’s not a yes-no answer, there’s a lot of grey” (Int-D006). However internal Ministry participants indicated a lack of an organisational structure to support integration of research activities through dialogue. Against this perspective was the view that “scientists are not necessarily good communicators” when it comes to bringing knowledge out into the everyday context (Int-D006). For example, an internal stakeholder stressed the importance of “getting your hands dirty” and “having that interaction with people who are actually trying to solve problems in different areas” (Int-D011). This was seen as particularly important to another on the development of practical understanding of “theory” through “research on the [farmers] needs through extension people” that “should be fed back into the design of R&D” where currently “it’s a bit of brokenness about that cycle” (Ext-D010).

Meanwhile the state government was concerned with taking advantage of the new opportunities emerging from the introduction of a carbon price at a federal level. The authors of the CCFGP were aware that setting a national target would lead to trade-offs in emissions reductions across its own industrial sectors and across states in which “a flexible policy tool like a trading scheme” is advantageous (VG, 2009b p. 7). It seems this was a critical development that circumvented all other activities, leaving the organisation with very limited alternatives to supporting CCA research without the certainty of an ETS. Some concern about how decisions could be supported was through better understanding of the implications of actions taken such as “how successfully we integrate the climate and emissions related information” or “how do we respond and adapt and change” (Ext-D009). It also concerned those involved in government in understanding “what's our adaptability in our policy” and
“where's the flexibility in using our policy space” (Ext-M008). For one of the managers the implications of forecasting were much more open ended where those involved were “coming to not consensus but coming to sort of an agreed picture” of what might happen and then “still going out to communities to get a reality check on that” (Ext-D001). However concern was illustrated in the view of one of the managers where they “keep hearing different perspectives” on what research needs are, which confronted them in knowing “how do you put this into a framework” (Int-D004). For example, they might go “and spend millions and millions of dollars on this genetically modified programme” and then when they take it out they realise “that the industry’s not going to be prepared to take the risk” (Int-D004).

The root definitions (RDs) or systems of interest we have formulated from the research data show how diverse the espoused purposes of CCA research were within the Ministry. These ‘system descriptions’ are findings of the research in their own right, but they were also designed to facilitate on-going systemic co-inquiry (Foster, Collins, Ison et al., 2016). In a future engagement opportunity, such as a second cycle of CCA research, we would use the RDs in a process (i) of checking out their applicability with respondents and (ii) for using in the design of future research interactions. Emergent interests and stakeholders could be used as a basis for defining and critically constructing a boundary for a systemic co-inquiry, e.g., for project development or for teasing out the strategic and operational implications of key staff implicitly enacting or managing such a diverse range of ‘systems of interest’. For example, a focus on resource constraints and considerations of making improvements to the efficiency or multiple use of resources could lead to new kinds of relationships and integration of research areas such as community, environmental and agricultural uses of water. An inquiry system that could accommodate this divergent set of purposes would work through a process of deciding together what tasks were to be performed by the system,
alongside issues that impacted on the performance of such tasks.

In the conclusion we reflect on our approach and how STiP could be used to support future co-inquiry systems that appreciate and respond to the dynamics of socio-ecological co-evolution with a changing climate.

5 Concluding remarks

An ultimate aim of initiating this project within the Ministry’s Systems Thinking and Systemic Science initiative (Figure 1) was to develop a systemic framework to assess potential climate change impacts and adaptation actions in agriculture and forestry systems at regional and state-wide levels. This analysis was designed to invite consideration by research managers, researchers and stakeholders of what a systemic and adaptive research governance framework for future CCA might look like. Our second inquiry strand (Figure 2) was initiated to create awareness of possible opportunities and to open up spaces for co-inquiry and how that could be supported or managed by dealing with climate impacts and adaptation uncertainty through social processes. Practices of research management in a Westminster-style bureaucracy require new modes of governance in which differences in research outcomes can be accommodated, including the unexpected (Clement & Standish, 2018), and how realisation of opportunities to innovate can be achieved; something that NPM is ill-equipped to achieve with top down goal development and tightly managed project delivery cycles (Eppel, 2016). The uncertainty of climate policy development experienced with changes in state and federal leadership at the time of our SI was not conducive to a second iteration of CCA research as funding models were put under pressure and CliChAP II failed

9 By systemic we mean something that has an appreciation of how it operates as a whole system through its integrated or articulated parts performing a function that means more than simply a sum of its parts. By adaptive we mean something that is responsive to changes in its environment such that it also maintains a sense of its distinction from the environment in which it operates as a self-organising intelligence.
to materialise in a way that participants expected. For some of those who had valued their relational investments in new research partnerships there was a need to shift their locus of research to facilitate the continuation of community-researcher co-inquiry (Sposito, Faggian & Harmeijn, 2013; c.f., Pretty & Chambers, 1993). Two of our authors relocated their research out of a centralised agricultural bureaucracy to a regional university in order to continue in their new stakeholder relationships built as a result of their CCA research activities both during and after the implementation of CliChAP.

Systems approaches are most useful when they are built into everyday practice, or where they are purposefully chosen to illuminate a situation of concern, or to chart a way forward when there is lack of clarity about purpose, or where direction is open to multiple interpretations or is contested (van Bommel, Blackmore, Forster & deVries, 2016; Rook & Watson, 2017). All too often it is assumed that because strategy is committed to text then it will be easy to follow and implement (Pelling et al., 2008; Agyris & Schön, 1974). However this assumption has been challenged by research approaches studying institutional change (Walby, 2013; Rankin, 2017); our engagement with the Ministry through this research also shows that this is not the case in practice. In fact, one of the limitations faced by research managers within the CliChAP portfolio was the lack of a common conceptualisation of the CCA research situation. This created particular demands on those responsible for ‘joining-up’ the research that was done and in articulating a coherent meta-narrative from the findings of the various components of CliChAP. Initiating a SI enabled us to open up and explore the usefulness of systems approaches for delving into participants’ conceptual as well as mental models (Norman, 1983) through descriptive and reflective aspects of participation in CliChAP; therefore extending the capacity of SSM to more effectively deal with uncertainty as an intellectual and a pragmatic concern (Argyris & Schön, 1974) in articulating relevant
From a pragmatist’s point of view knowing how we know and what shapes and limits inquiry is an important condition of recognising how an organisation impacts on and is impacted by its environment (c.f., Weisser, 2014). Moreover as Tregidga, Kearins & Milne (2013) note assumptions embedded in documents, e.g., about ‘technological advancement, continuous improvement, and efficiencies’ (p. 102) may limit the possibilities for learning about the socio-ecological conditions through which effective adaptations towards sustainable development will be achieved (also Pelling et al., 2008). Following codified or instructional processes are not necessarily going to produce an appropriate trajectory for learning in a system undergoing change, thus managerial approaches are needed that have dynamic learning capacity and are more open to creative processes of experimental organisational learning. Constructivist approaches are better suited to such learning (Pretty & Chambers, 1993, p. 186) in which understanding emerges from the interactions between prior conceptions and the actions they inform, as an iterative social process of feedback and reconceptualization (Roome & Louche, 2015). From a systems point of view, this is a lack (possibly) of capability within organisational structures to see outside of the work process imperatives. There is a special kind of entrepreneurship within organisations that are less conservative, that can test and challenge rationales of organisational culture. We wonder whether the simple view also often gets adopted as a way of mapping through the volatile political environments that Ministries often find themselves in. Such characteristics are not adequately captured through conservative agricultural bureaucracies because of their inability to embed learning within organisational routines.

Our SI has revealed possible systems of interest that could be drawn upon to facilitate the
development of a systemic co-inquiry that opens up areas for learning about what adaptation looks like from different viewpoints (Selby, 2014; Weisser, 2014) but also how adaptation can be achieved across diverse interacting research activities. Making the distinction between a system of inquiry and the effects of its actions is a reflexive process; there are pragmatic and institutional dimensions to this (Berling and Bueger, 2017). The underlying premise and set of assumptions leading to the inquiry must be open to reconsideration. Appreciating the assumptions of our SI has also provided an opportunity for us as researchers to reflect on our own practice and conceptualisations of STiP. We used SSM to articulate the problem, social and political situation by drawing on participants’ descriptive and reflective accounts of research practice in relation to documents and observations. Our work is similar and may provide a useful comparison with that of institutional ethnography (Tummons, 2017), however our SI takes on the multi-positional agency of actors as well as their constraints; realising tensions between perspectives as a means to reconsider the boundaries of research management practice together with our participants.

Participants’ descriptions indicated a transitional state of research practice in relation to the challenges of climate change and their reflections as one of emergent relations that could be used to redefine the way research is practiced. In opening this inquiry our core concern became that research management practice was in need of revitalisation. Traditions of new public management within the bureaucracy that were characterised by project management processes heavily guided by investment accountability failed to maintain efforts of research integration as an emergent and dynamic property throughout the duration of CliChAP. Our inquiry presupposed that having committed ideas to text is not enough to shift practice, and that socially constructed norms of the past require more than stated aims. The need for collaborative and integrative approaches, at the national and state level preceding the
initiation of CliChAP, clearly had limitations in being able to realise a change in practice. An ability to deal with CCA as a ‘super wicked’ problem needs to enable the generation of outcomes that could redirect science and policy through adoption of SI as a novelty for opening new trajectories in socio-ecological co-evolution (Levin et al, 2012).

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IAASTD – International Assessment of Agricultural Knowledge, Science and Technology for Development


IPCC – Intergovernmental Panel on Climate Change


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