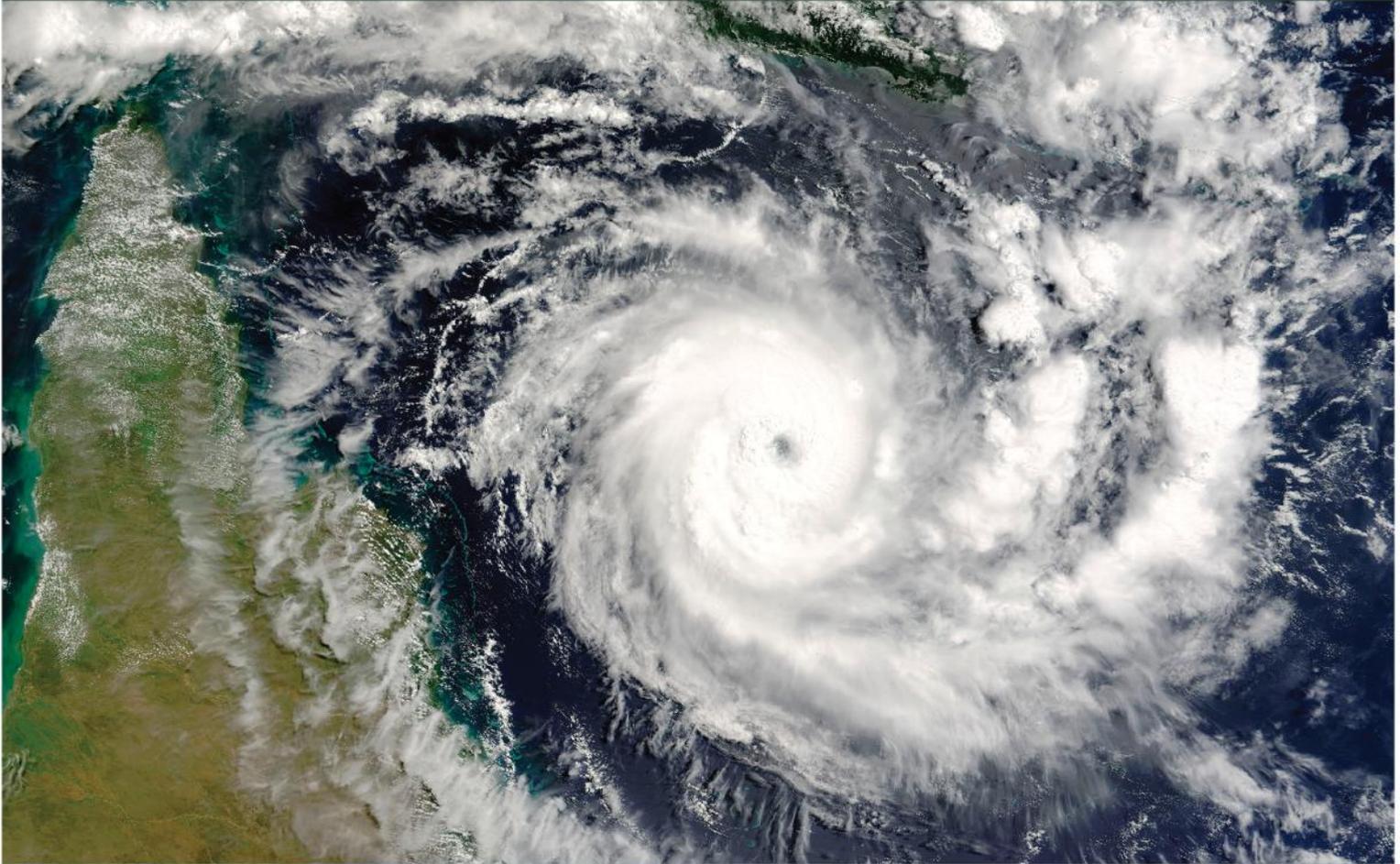




WET TROPICS  
NRM CLUSTER

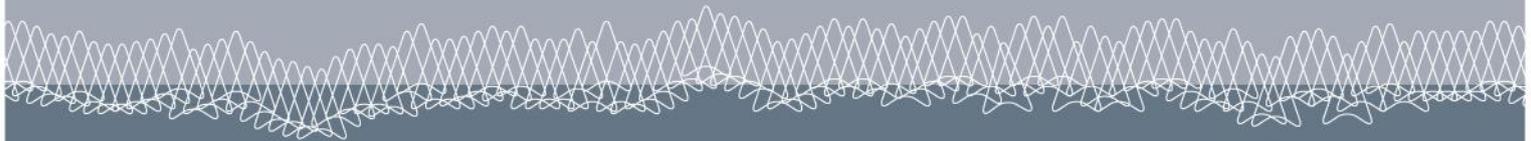


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FOR AUSTRALIA'S NRM REGIONS



# Adaptation Pathways and Opportunities for the Wet Tropics NRM Cluster region

Volume 2. Infrastructure, Industry, Indigenous peoples, Social  
adaptation, Emerging planning frameworks, Evolving  
methodologies and Climate adaptation planning in practice.



Edited by Catherine Moran, Stephen M. Turton and Rosemary Hill

# 9. Evolving methodology for identifying climate adaptation pathways and options

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## IN A NUTSHELL

- A ‘co-research’ approach involving multiple scientific disciplines and genuine collaboration between researchers and NRMs is critical.
- Participatory planning approaches are essential to the development of useful adaptation plans.
- Social network analysis is a useful means of identifying key actors, networks and institutions for collaboration.

## Precis

This chapter provides an update on progress from the ‘Participatory Scenarios and Knowledge Integration Node’ of the Wet Tropics Cluster (WTC) region. Since the first workshop, led by the ‘Participatory Scenarios and Knowledge Integration Node’ in April 2013, members of this research node, in collaboration with the natural resource management (NRM) organisations, have initiated a wide range of research activities, based on the findings from this workshop and discussions with the four NRM organisations of the Wet Tropics Cluster. Appendix B summarises these transdisciplinary research activities, some of which are completed, while others are in progress. Our transdisciplinary research is showing that, based on the differences identified in the initial workshop with members of the Brokering Hub and discussions with staff of the four NRM organisations, the research needed to support these four NRM organisations in their planning for climate change differs considerably. This is not only a reflection of the differences between the four NRM regions in their biogeography, demography, and governance but also a reflection of past and current research activities carried out in these four NRM regions such as through the National Environmental Research Program (NERP) and the Rural Industries Research and Development Corporation (RIRDC). The key messages associated with each of the topics addressed in this chapter are:

TOPIC	KEY MESSAGES
Evolving methodology	<p>143. The co-research approach, i.e. the Brokering Hub and the co-research cycle, is critical to the success of the Wet Tropics Cluster project.</p> <p>144. Research (synthesis) needs to be driven by the NRM organisations of the Wet Tropics Cluster, and needs broad stakeholder support to facilitate development of ‘no regrets’ adaptation strategies.</p> <p>145. Transparent and open communication is critical for improving understanding about issues and supporting learning among Brokering Hub members (and among staff of the four NRM organisations).</p> <p>146. The research approaches and methods taken by the ‘Participatory Scenarios and Knowledge Integration Node’ need to be flexible, adaptable and tailored to the needs of each of the four NRM organisations.</p>

TOPIC	KEY MESSAGES
	<p>147. Research syntheses need to involve careful processes of translation across the ‘boundaries’ between the “knowledges” of research and practice.</p> <p>148. Close collaboration among researchers of different scientific disciplines, NRM staff and stakeholders within the NRM regions is critical to identification of adaptation pathways and options.</p>
Adaptation pathways and options	<p>149. Identification of climate adaptation pathways and options requires participatory approaches and collaboration with stakeholders representing the broad interests and sectors across the NRM region.</p> <p>150. Social network analysis (SNA) can assist in the identification of key actors, networks, and institutions that are important to collaborate with.</p> <p>151. Participatory scenario planning is a powerful tool to engage multiple stakeholders in identifying adaptation pathways and options to address climate change and other key drivers of change in the region.</p>

## Introduction

In April 2013 the ‘Participatory Scenarios and Knowledge Integration Node’ led a half-day workshop with members of the Brokering Hub to identify the key issues and drivers of change in the four NRM regions based on the knowledge and experiences of the members of the Brokering Hub (Stream 1 and Stream 2). The outcomes of this workshop were delivered to the Australian Government in a Milestone report in May 2013 and informed the research of our node (Bohnet *et al.* 2013). In Appendix B we provide an overview of all the activities undertaken by members of our Node. In subsequent sections we describe the activities in more detail and provide the rationale for each of the activities.

The aim of this chapter is to illustrate how the various activities carried out by our research node support NRM planning for climate change. In particular, we aim to show how participatory scenario planning can support transdisciplinary research activities and enables identification of different types of knowledges, knowledge integration, and building of adaptive capacity.

## Adapting to the impacts of climate change – how science informs NRM planning for climate change

### Scientists and NRM practitioners working together in a Brokering Hub

**The co-research approach, i.e. the Brokering Hub and the co-research cycle, is critical to the success of the Wet Tropics Cluster project.**

A prerequisite and critical to the success of the Wet Tropics Cluster (WTC) project is this innovative co-research approach that has been taken by the project team, and the establishment of the Brokering Hub at the beginning of the project (see Chapter 1, Figure 1.2). The co-research cycle adopted includes stages that provide for: system analysis; processes and tools to support knowledge translation and integration; and updating through social learning (see Chapter 1, Figure 1.3).

Participation in regular meetings of the Brokering Hub is critical to the research carried out by the ‘Participatory scenarios and knowledge integration node’ since its research is largely driven by the needs of the NRM organisations (Bohnet *et al.* 2013). However, participation in Brokering Hub meetings is also critical as a means to reach an improved understanding of the

science, approaches and methods, e.g. landscape approach, social network analysis, participatory scenario development, that may be useful in assisting the NRM organisations in their planning for climate change. In addition, participation in the Brokering Hub also enables the 'Participatory Scenarios and Knowledge Integration Node' to gain a better understanding of the research carried out in the other research nodes and to support and capitalise on their research activities (connection between the 'Participatory Scenarios Node' and other research nodes via Brokering Hub shown in Figure 1.2). For example, members of the 'Participatory Scenarios and Knowledge Integration Node' contributed substantially to, and thereby supported, the research carried out by the 'Science Synthesis Node' (Hilbert *et al.* 2014). At the same time, the 'Participatory Scenario and Knowledge Integration Node' used extracts from the suite of key messages from the science synthesis report (Hilbert *et al.* 2014) in a participatory scenario planning workshop (Bohnet and Bell 2014) to inform workshop participants.

The co-research cycle (Chapter 1, Figure 1.3) is based on recognition that 'knowledges' generated under different disciplinary matrices, and under research or practice settings, are of different kinds and that any joint use will require careful processes of translation across the 'boundaries' between knowledge systems (Vatn and Vedeld 2012). Processes of conscious boundary management that include knowledge co-production, mediation, translation, and negotiation have been identified as necessary to build integrated knowledge for generation of adaptation pathways and sustainability solutions (Cash *et al.* 2006). A growing body of research has emerged that analyses boundaries and boundary work to link different knowledge domains in sustainability science (Robinson and Wallington 2012). Our cycle is based on the six stages identified by Hill *et al.* (2010) which emphasises the need to pay attention to tools for developing knowledge integration and shared understanding. In addition to the participatory scenarios, cultural mapping and social network analysis (SNA), the ongoing discussions at the Brokering Hub are critical to identifying issues of knowledge translation and boundary management.

## Workshop to identify key issues and drivers of change in the Wet Tropics Cluster NRM regions

**Research (synthesis) needs to be driven by the NRM organisations of the Wet Tropics Cluster, and needs broad stakeholder support to facilitate development of 'no regrets' adaptation strategies.**

**Transparent and open communication is critical for improving understanding about issues and supporting learning among Brokering Hub members (and among staff of the four NRM organisations).**

One of the initial steps that need to be taken in the process of identifying climate adaptation pathways and options is identification of key issues and drivers of change. A workshop, led by the 'Participatory Scenarios and Knowledge Integration Node' was organised with the members of the Brokering Hub to identify key issues and drivers of change in the four NRM regions of the WTC region. This workshop provided the opportunity for scientists and managers to work together and to get a better understanding of the key issues and drivers of change in the four NRM regions of the Wet Tropics Cluster. The output from this workshop was a milestone report delivered to the Australian Government. The outcomes of this workshop (Bohnet *et al.* 2013) informed the research synthesis that has been and is currently carried out by the 'Participatory Scenarios and Knowledge Integration Node'.

## Synthesis of climate change knowledge and planning practices of the Wet Tropics Cluster NRM organisations

**The research approaches and methods taken by the 'Participatory scenarios and Knowledge Integration Node' need to be flexible, adaptable and tailored to the needs of each of the four NRM organisations.**

To establish a baseline about current climate change knowledge in the four NRM organisations and their planning practices, our science node carried out a

review of relevant documents, which the NRM organisations provided. To supplement the review and clarify questions that arose from the review, we conducted interviews with NRM staff members. The output from this research, a milestone report, was delivered to the Australian Government (Lyons *et al.* 2013). The outcomes, five key messages, were presented to the NRM organisations in a Brokering Hub meeting and the report (Lyons *et al.* 2013) was made available. These five key messages further informed the research in our science node.

## Contribution to research led by other research nodes

**Research syntheses need to involve careful processes of translation across the ‘boundaries’ between the “knowledges” of research and practice.**

**Close collaboration among researchers of different scientific disciplines, NRM staff and stakeholders within the NRM regions is critical to support identification of adaptation pathways and options.**

The first science synthesis report (Hilbert *et al.* 2014) responded to a list of ‘Priority science deliverables’ initially prepared by the NRM organisations during the development of the project proposal, and subsequently updated through the Brokering Hub (Appendix A, Volume 1). The structure of the report was framed by this needs analysis, and lead authors were asked to direct their synthesis to these topics. Nevertheless, the evaluation conducted at the Brokering Hub meeting identified that authors did not include key information that was requested, and that insufficient review and interaction occurred around the document. Key authors on the other hand identified that meeting the exact requirements of the NRM groups would require a multi-year research program rather than a synthesis from a body of science largely driven by other needs. This again highlights the requirements for careful translation and management across the knowledge boundaries between research and practice.

Researchers from our science node contributed substantially to the science synthesis report (Hilbert *et al.* 2014) as outlined in Appendix B. This report was a

major project deliverable to the Australian Government and our four NRM collaborators. While the preparation, coordination and writing of these chapters was a time-consuming exercise it provided opportunities for collaboration amongst WTC researchers from the different science nodes and additional researchers from outside the project with specific expertise relevant to the research of the WTC project. Special attention was paid to the specific issues associated with knowledge integration across Indigenous and western world-views. The outputs, i.e. extracts from the key messages from each of the chapters, have already been displayed during scenario planning workshops in the Reef Catchments NRM region and will further inform the research in our node. Overall, the science synthesis report improves our understanding of the science that can support NRM adaptation planning for climate change.

To improve communication and co-ownership of key messages from the science synthesis report within the NRM groups, a brochure was developed in collaboration with the NRM groups, led by Ro Hill and Cath Moran from the science team (Hilbert *et al.* 2014b), also outlined in Appendix B. Science teams provided the key messages and the NRM groups provided most of the images, and influenced layout and design.

## Cultural Heritage Mapping and participatory scenario planning with Traditional Owners in the Reef Catchments NRM region

**Identification of climate adaptation pathways and options requires participatory approaches and collaboration with stakeholders representing the broad interests and sectors across the NRM region.**

Engagement with a broad range of stakeholders, sectors and community groups is essential for developing effective ‘no regrets’ adaptation pathways. For some groups who may be disadvantaged and have a reduced capacity to engage in collaborative adaptation planning opportunities (e.g. some Traditional Owner groups), additional effort may be required to ensure

their needs and perspectives are incorporated into adaptation planning processes. This case study, initiated by Reef Catchments and our research node, consists of two components: a land use and occupancy mapping exercise (cultural heritage mapping) and an adapted scenario planning activity. The aim of this case study is to explore and critically assess the appropriateness of planning and community engagement tools to integrate knowledge, and include Indigenous cultural values, into regional planning. An Indigenous-driven process has been adopted as Indigenous driven processes have demonstrated greater capability for including Indigenous perspectives and protection of Indigenous intellectual property (Christensen and Grant 2007; Hill *et al.* 2012; Sillitoe and Marzano 2009).

### **Participatory Cultural Heritage and Land Use and Occupancy Mapping**

Participatory mapping is a general term for gathering and mapping spatial information to help communities learn, discuss, build consensus, and make decisions about their communities and associated resources. The participatory cultural heritage mapping exercise will involve researchers who support the Traditional Owners to collect, depict, and interpret new information to assist them and Reef Catchments NRM to make resource management decisions.

Participatory mapping is a powerful tool that increases Traditional Owner involvement and provides a means for participants to express their ideas in an easily understandable visual format. Participatory mapping has previously been used in the following ways:

- to create maps that represent cultural resources, community values, perceptions of alternative scenarios and usage
- to gather traditional knowledge and practices for assessment or monitoring
- to identify data gaps
- to inform other data collection methods (e.g. formal surveys, interviews, planning workshops)
- to facilitate the decision making process
- to empower stakeholders in resource negotiation processes

- to conduct trend analyses.

Participatory mapping can simultaneously provide:

- a way to engage Traditional Owner groups near and far
- objective local information on resources
- a means to strengthen traditional knowledge and practise from their Traditional Owner group(s)
- information on how Traditional Owners perceive, value and use these resources
- a focal point for discussion on climate change impacts and other issues/impacts on cultural heritage
- a valuable tool to support decision making
- graphical and easily understandable communication tools.

In the land-use use occupancy mapping Traditional Owners define what they want to map and the information they make public. The aim of the mapping exercise is to show the different ways that people are connected to particular features of their country and to draw the boundaries of that country. The types of information that can be mapped include use of and access to country, such as fishing, camping, art and story sites and historical use of land. Mapping can enhance engagement with other stakeholders, to visualise issues and resources and stimulate discussion.

### **Participatory Scenario Planning On-Country**

Participatory scenario planning follows the cultural heritage mapping exercise. The maps will be the basis for discussion with the Traditional Owners to discuss their values of their country and develop scenarios and adaptation options for their country.

One of the key attributes of participatory scenario planning is the involvement of multiple stakeholders in the scenario development process (Albert *et al.* 2012; Bohnet 2010; Bohnet *et al.* 2011; Johnson *et al.* 2012). While this is critical for robust participatory scenario outcomes, the inclusion of Indigenous knowledge may require its own process for several reasons. These

include adaptation of tools to support: Indigenous ways of communication and representation especially cultural values and connection to country; Indigenous interpretation and meaning that is based on Indigenous ways of knowing; negotiation of consensus which may require different types of agreement based on governance arrangements; alternative perspectives of time and scale; and recognition of Indigenous interests in the engagement process. This case study will use an Indigenous driven process to explore the capability of participatory scenario planning to address the Indigenous perspective.

Outputs from this case study will include a combination of the following: Traditional Owner approved maps of country, cultural heritage maps for the Traditional Owners, Traditional Owner vision or plan for country that include adaptation options, narratives and stories. A journal article and summary results sheets, for the Brokering Hub members and the Traditional Owner group, will be published from this work.

This case study will offer a unique approach to incorporating an Indigenous driven process and perspective into regional NRM planning. Through this research we will identify conditions, approaches and processes that support or limit the integration of Indigenous knowledge into a regional NRM governance setting.

## Social Network Analysis

**Social network analysis (SNA) can assist in the identification of key actors, networks, and institutions that are important to collaborate with.**

This social network analysis (Ahammad *et al.* 2013) case study, initiated by Terrain NRM and our research node, takes a broad structural view of knowledge integration in biodiversity management. This research investigates how knowledge and information is negotiated and brokered among conservation actors, at the broader structural network level. The SNA will be based on the institutional arrangements and contributions of different types of knowledge to biodiversity connectivity in the Terrain NRM region.

The aims of the SNA are to investigate and document:

- the relational structural arrangements that support on-ground works for biodiversity
- the types of relationships that support particular types of knowledge that contribute to biodiversity connectivity
- the sharing of knowledge and the use of different types of knowledge that support decision-making
- gaps and opportunities to improve collaboration in the knowledge networks to support effective biodiversity outcomes.

This project will investigate how different types of knowledge are shared and used to support decision-making for biodiversity management in the Wet Tropics Cluster region.

SNA is becoming a recognised and accepted tool to examine relationship ties and types of interactions that occur among actors in NRM (Bodin *et al.* 2011; Janssen *et al.* 2006). SNA can identify exchange and connections among stakeholders that occur through institutional arrangements, information paths and resource relationships (Bodin *et al.* 2011; Hahn *et al.* 2006). An understanding of the interactions between organisations can improve our knowledge of how governance arrangements influence NRM in each region, the types of bonds and bridging relationships between agencies, and improve the ability of agencies to identify opportunities to invest resources effectively for biodiversity outcomes. An understanding of the structural relations in a network can provide clarity about the knowledge and power interactions that shape those relations and elucidate areas where action can be taken to reduce vulnerability (Weiss *et al.* 2012).

This work will focus on the knowledge relationships, as well as the quality of knowledge engagement, between agencies contributing to biodiversity in the Wet Tropics Cluster region. Increased biodiversity is a strategic NRM outcome for Terrain NRM. The SNA will be conducted in the Terrain NRM region and will explore how different actors in conservation work contribute to governance of biodiversity connectivity. This case study will complement the completed spatial strategic offset corridor maps developed by Terrain NRM. At least three strategic corridors will be targeted for this work, a

coastal, peri-urban and hinterland area, based on Terrain NRM's off-set corridor maps.

Identification of an initial set of key actors involved in on-ground biodiversity corridor work will be completed with Terrain NRM staff. This will be followed by a snowball selection method. The case study will engage actors operating at different NRM scales, including industry, Traditional Owner groups and property owners.

The SNA will occur at the institutional level and will involve several stages:

1. scoping of the social network analysis with Terrain NRM based on their NRM program and their strategic offset corridor spatial maps
2. exploratory qualitative exercise, focus groups sessions with some of the stakeholder groups on information sharing and their decision networks to guide development of the quantitative survey (spatial map will be used to determine which groups to meet)
3. discussion of the findings and the development of the survey with Terrain NRM
4. development of a survey that will form the basis of mapping the social network of biodiversity corridors
5. pilot test and adjust questionnaire as required
6. conduct the SNA survey, through meetings and phone conversations
7. development of the social network using exponential random graph modelling
8. review of the initial findings with Terrain NRM and supervisor to design the second stage of the study, a qualitative survey
9. pilot test then conduct focused qualitative survey on particular relationships in the network to identify how knowledge is negotiated, exchanged, translated, and/or transformed and any interactions between scales
10. review of findings with Terrain NRM and supervisor and discuss implications for NRM planning for climate mitigation
11. write up results – report and paper.

The outputs from this case study will include:

- a journal article
- summary report for Terrain NRM and participants, where requested
- recommendations for actions that will strengthen decision-making and knowledge sharing for biodiversity management.

Outcomes include:

- improved understanding of the key variables that influence, and can acted on to, to build on the benefits from existing biodiversity offset corridors
- improved planning and engagement strategies in the NRM community for effective biodiversity management.

## Scenario planning workshops in the Reef Catchments NRM region

**Participatory scenario planning is a powerful tool to engage multiple stakeholders in identifying adaptation pathways and options to address climate change and other key drivers of change in the region.**

A series of regional stakeholder workshops were held in collaboration with Reef Catchments NRM to assist with their incorporation of climate change adaptation measures into their updated NRM plan. Earlier Brokering Hub meetings with NRM representatives had identified a range of issues relevant to the NRM region that would affect stakeholder engagement and adaptation planning processes, including mining industry growth, port developments within and adjacent to the NRM region, and a degree of climate change scepticism among some community stakeholders. A participatory scenario workshop process was applied to address these and other regionally relevant issues and elicit broad stakeholder participation into the identification of:

1. community and stakeholder values associated with the NRM region
2. key drivers of change in the NRM region
3. the risks and opportunities associated with those drivers of change

4. strategies and actions to reduce/mitigate risks and capitalise on opportunities
5. key players and potential working groups to implement the identified strategies and actions.

Stakeholder workshops were held in two stages:

1. initial workshops to address (i) to (iii) above, held in Mackay (12/2/14) and Proserpine (13/2/14)
2. a follow-up workshop to address (iv) and (v) above, held in Mackay (17/6/14).

The initial workshops were held in two centres within the Reef Catchments NRM region as organisers

considered the likelihood of intra-regional differences in key issues and drivers of future change identified by participants from different parts of the NRM region. The follow-up (Stage 2) workshop was held in Mackay, synthesising key outcomes of both initial workshops for regional stakeholders to review, prioritise and develop collaborative strategies and actions. Key details and outcomes of the workshops are summarised below in Table 9.1. Full details of the workshop structure, participants and outcomes are reported in Bell *et al.* (in prep). Workshops were held at a hired venue, with independent, professional facilitators appointed to mitigate any potential perception of bias in the process.

**Table 9.1 Summary of Reef Catchments participatory scenario workshop in F.Y. 2013/14.**

WORKSHOP	PARTICIPANTS AND SECTORS	KEY OBJECTIVES	KEY OUTCOMES
<b>Stage 1: Mackay (12/2/14)</b>	<b>34 total; including:</b> <ul style="list-style-type: none"> <li>• Local government</li> <li>• State government</li> <li>• Emergency management</li> <li>• Traditional Owners</li> <li>• Conservation NGOs</li> <li>• Landcare</li> <li>• Great Barrier Reef Marine Park Authority</li> <li>• Regional Development</li> <li>• Agriculture industry</li> <li>• Tourism Promotion Rep.</li> <li>• Research (CSIRO &amp; JCU)</li> <li>• Reef Catchments NRM</li> </ul>	<ol style="list-style-type: none"> <li>1. Identify participant values associated with the MWI region.</li> <li>2. Review and identify drivers of change, key issues and associated impacts in region.</li> <li>3. Identify opportunities and risks associated with drivers of change.</li> <li>4. Preliminary scoping of actions, strategies and collaborations to address opportunities and risks.</li> </ol>	<b>Values included:</b> <ul style="list-style-type: none"> <li>• Small population</li> <li>• Natural areas</li> <li>• Favourable climate</li> <li>• Lifestyle</li> <li>• Recreation opportunities</li> </ul> <b>Drivers included:</b> <ul style="list-style-type: none"> <li>• Population growth</li> <li>• Economic development from mining &amp; ports development</li> <li>• Climate change</li> <li>• Community capacity, skills and education</li> </ul> <b>Opportunities included:</b>

WORKSHOP	PARTICIPANTS AND SECTORS	KEY OBJECTIVES	KEY OUTCOMES
<b>Proserpine</b> (13/2/14)	<b>14 total; including:</b> <ul style="list-style-type: none"> <li>Local government</li> <li>Emergency management</li> <li>Landcare</li> <li>Regional Development Corp.</li> <li>Agriculture industry</li> <li>Tourism industry</li> <li>Research (CSIRO &amp; JCU)</li> <li>Reef Catchments NRM</li> </ul>		<ul style="list-style-type: none"> <li>Regional infrastructure investment</li> <li>New agricultural crops &amp; diversification</li> <li>Carbon market opportunities</li> <li>Business &amp; retail growth</li> </ul> <b>Risks included:</b> <ul style="list-style-type: none"> <li>Natural resource degradation</li> <li>Cultural shift and loss of values</li> <li>Water use competition and scarcity</li> <li>Economic inequality</li> <li>Loss of agricultural land</li> <li>Erosion of Traditional cultural heritage</li> <li>Reduces lifestyle quality</li> <li>Coastal flooding and storm impacts</li> </ul>
<b>Stage 2: Mackay</b> (17/6/14)	<b>31 total; including:</b> <ul style="list-style-type: none"> <li>Local government</li> <li>State government</li> <li>Education sector</li> <li>Traditional Owners</li> <li>Conservation NGOs</li> <li>Landcare</li> <li>Great Barrier Reef Marine Park Authority</li> <li>Insurance industry</li> <li>Agriculture industry</li> <li>Mining industry</li> <li>Research (CSIRO &amp; JCU)</li> <li>Reef Catchments NRM</li> </ul>	<ol style="list-style-type: none"> <li>Review and prioritise key drivers, opportunities and risks.</li> <li>Develop collaborative strategies and actions to address opportunities and risks</li> <li>Identify key players and potential collaborations to implement strategies and actions.</li> </ol>	<b>Strategies and actions included:</b> <ul style="list-style-type: none"> <li>Professional development for teachers</li> <li>Development of a multicultural centre and creation of a contact list to facilitate improved engagement with local Traditional Owners.</li> <li>Development of regional renewable energy strategy</li> <li>Planning mechanisms to preserve and prevent development over prime agricultural land</li> <li>Establishment of a community development consultation forum.</li> <li>Build climate change adaptation framework into NRM and council planning.</li> </ul>

As reported in Bell *et al.* (in prep), the diversity of stakeholder participants at the Reef Catchments workshops was an aspect that was greatly appreciated by the workshop participants. The broad representation of a wide range of community sectors and industries in the region provided an opportunity for identifying shared values of the region, and for the acknowledgement of opportunities and threats associated with different groups and sectors.

### Regional values and issues

Common values identified across the Stage 1 workshops included an appreciation of the 'sense of community', small town size, access to good services (e.g. health, schooling, infrastructure), agreeable climatic and weather conditions and the diversity of the natural landscape, including proximity to both the Great Barrier Reef and hinterland ranges. Regional economic

diversification arose as a key issue at both the Mackay and Proserpine workshops. Current dominant industry sectors include agriculture (primarily sugar cane and grazing), mining and tourism (principally in the Whitsundays region). Concerns about the reliance on mining for economic viability, and the impacts of this industry on both social and environmental issues were raised in both Mackay and Proserpine, reflecting the strong influence of this sector on the region. A key distinction between the two locations, was that the Mackay area had experienced a ‘boom’ but is now seeing a downturn in investment, whereas an impending ‘boom’ for the Whitsundays region was expected following the federal government’s recent approval of expansions to the Abbott Point coal export facility. The strength of the mining sector was identified as a key driver of both opportunities and risks to the future of the region’s landscape, other industries and the social well-being of communities within the region. While invitations were sent, unfortunately no mining industry representatives were able to attend the Stage 1 workshops; however, mining representation was achieved at the Stage 2 workshop.

### Key drivers in the region

At both Stage 1 workshops, Reef Catchments staff provided a summary snapshot of the socio-economic and climactic drivers that are currently and likely to impact on the future of the region. These included:

- population growth (47% by 2031)
- capacity – resources, people (e.g. low per capita higher education attainment, high per capita trade skills associated with mining and construction)
- climate change (high variability accepted as regional norm, extreme events projected to increase in intensity, warming trend already evident, sea level rise expected to impact low lying areas).
- economic sectoral growth/ decline (e.g. growth in mining and related industries, decline in relative economic importance of agriculture)

### Risks and opportunities

At the Stage 1 workshops, the main impacts identified that were associated with the mining ‘boom’ included

increased urban and industrial development and an increasingly transient population. Impacts identified from such growth included reduced social connectivity and community capacity, degradation of the natural environment, and impacts to other sectors including tourism and agriculture. In Proserpine, concerns around mining included impacts on future tourism, the health of the Great Barrier Reef (in particular water quality from port dredging), biodiversity loss, industrial and urban encroachment on good quality agricultural land, and risks to the viability of the local sugar mill.

The risks associated with climate change were acknowledged by participants in all workshops, despite the earlier identification of climate change scepticism within the community. Contributions by emergency services representatives, who shared details of response plans and activities associated with extreme weather events in recent years contributed significantly to the identification of risks, opportunities and strategies. Similarly, a presentation by an insurance industry representative at the Stage 2 workshop on insurance industry statistics, policy and issues in the north Queensland region provided excellent additional contextual information to inform the development of risk reduction and mitigation strategies by the workshop participants (full details reported in Bell *et al.* in prep).

### Actions, strategies and collaborations

A range of actions, strategies and collaborations were identified in both the Stage 1 and Stage 2 workshops, to address the identified opportunities and risks relevant to the NRM region (see summary in Table 9.1 above, and outcomes reported in Bell *et al.* in prep for details). A prioritisation process was applied in the Stage 2 workshop to categorise actions/strategies according to (a) their breadth of benefits to community sectors, industries and the natural environment, and (b) their affordability in terms of economic investment required, and the likely political will to achieve implementation. Considerations were also given to potential negative side-effects and trade-offs that would affect other sectors, community groups and/or the environment. Strategies and actions that scored the highest in both categories were flagged as a high priority for actioning

and key players associated with implementation were identified for some examples (see Bell *et al.* in prep for further details and an outline of the Stage 2 workshop processes).

### Future directions

Following reporting of workshop outcomes to participants (Bell *et al.* in prep), further work is planned, involving the Participatory Scenarios and Knowledge Integration Node and Reef Catchments NRM staff, to develop spatially explicit scenarios and to provide support for community working groups to implement the identified adaptation strategies and actions. Participatory scenario methods, supported by spatial tools, and an ongoing participatory action research approach to advancing NRM adaptation planning will form a key component of the 'evolving methodology,' that is responsive to locally-specific contexts, issues, opportunities and problems that characterise natural resource management and planning.

## Summary and conclusions

The research and communication activities carried out by the 'Participatory Scenario and Knowledge Integration Node' have been driven by the needs of the four NRM organisations that are part of the Wet Tropics Cluster. As a result, a wide range of transdisciplinary research activities have been completed and are underway to address the diverse needs of the four NRM organisations (Appendix B). These activities comprise a wide range of research approaches and methods, including desktop based reviews, interviews and participatory research approaches such as scenario and cultural heritage planning, to support identification of climate adaptation pathways and options.

While the NRM adaptation checklist: Supporting climate adaptation planning and decision-making for regional NRM (Rissik *et al.* 2014) provides an excellent resource for NRM practitioners, the research carried out by our science node explicitly addresses the four challenges outlined in the NRM adaptation checklist:

1. making decisions for multiple possible futures
2. employing flexible and adaptive planning processes

3. explicitly identifying and preparing for likely future decisions
4. strengthening the adaptive capacity of people and organisations.

We acknowledge that our research is limited, in particular by the resources (time and funding) that we have available. However, the co-research and collaborative approach taken in the Wet Tropics Cluster provides a framework and opportunity to strengthen the adaptive capacity of the people and organisations involved in the project. Strengthened adaptive capacity seems to be critical to address all other challenges and the participatory approaches employed in our research activities are a pathway to achieve this. In particular, the participatory scenario planning workshops provided opportunities to address the four challenges simultaneously and to enhance collaboration among people and organisations.

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