

 Open access • Journal Article • DOI:10.1080/13549839.2012.665857

Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia

— [Source link](#) 

[Donna Green](#), [Stephanie Niall](#), [Joe Morrison](#)

Institutions: [University of New South Wales](#), [Yale University](#), [Charles Darwin University](#)

Published on: 16 Mar 2012 - [Local Environment](#) (Routledge)

Topics: [Vulnerability assessment](#), [Vulnerability](#), [Social vulnerability](#), [Government](#) and [Adaptive management](#)

Related papers:

- ['Strange changes': Indigenous perspectives of climate change and adaptation in NE Arnhem Land \(Australia\)](#)
- [Climate change vulnerability and social development for remote indigenous communities of South Australia](#)
- [Adaptation, adaptive capacity and vulnerability](#)
- [The vulnerability of Australian rural communities to climate variability and change: Part I - Conceptualising and measuring vulnerability](#)
- [Informing regional level policy development and actions for increased adaptive capacity in rural livelihoods](#)

Share this paper:    

View more about this paper here: <https://typeset.io/papers/bridging-the-gap-between-theory-and-practice-in-climate-xxpbt3bb1>

3-2012

Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia

Donna Green

Stephanie Niall

Joe Morrison

Follow this and additional works at: <https://ir.lib.uwo.ca/aprci>



Part of the [Environmental Policy Commons](#)

Citation of this paper:

Green, Donna; Niall, Stephanie; and Morrison, Joe, "Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia" (2012). *Aboriginal Policy Research Consortium International (APRCi)*. 412.

<https://ir.lib.uwo.ca/aprci/412>

This article was downloaded by: [University of Western Ontario]

On: 18 November 2012, At: 07:44

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Local Environment: The International Journal of Justice and Sustainability

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/cloe20>

Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia

Donna Green^a, Stephanie Niall^b & Joe Morrison^c

^a Climate Change Research Centre, University of New South Wales, Mathews Level 4, Kensington, 2052, Australia

^b Yale School of Forestry and Environmental Studies, New Haven, CT, USA

^c North Australian Indigenous Land & Sea Management Alliance (NAISMA), Charles Darwin University, Darwin, Australia

Version of record first published: 07 Mar 2012.

To cite this article: Donna Green, Stephanie Niall & Joe Morrison (2012): Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia, *Local Environment: The International Journal of Justice and Sustainability*, 17:3, 295-315

To link to this article: <http://dx.doi.org/10.1080/13549839.2012.665857>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings,

demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

Bridging the gap between theory and practice in climate change vulnerability assessments for remote Indigenous communities in northern Australia

Donna Green^{a*}, Stephanie Niall^b and Joe Morrison^c

^aClimate Change Research Centre, University of New South Wales, Mathews Level 4, Kensington, 2052, Australia; ^bYale School of Forestry and Environmental Studies, New Haven, CT, USA; ^cNorth Australian Indigenous Land & Sea Management Alliance (NAILSMA), Charles Darwin University, Darwin, Australia

This paper considers the Australian federal government's approach to climate adaptation policy for remote northern Indigenous communities through the close examination of a seminal Scoping Study. This approach is taken to illustrate the lag between adaptation theory and practice, and to highlight important considerations to enable the development of a just and effective policy. The analysis suggests that policy in this area would benefit from the further consideration of three factors, namely the role of uncertainty in climate policy, the need for meaningful consultation with communities, and the benefit of integrating contextual and bottom-up assessment of vulnerability with decision-making in an iterative manner. The paper concludes by suggesting that the current approach to vulnerability assessment is insufficiently nuanced to allow an adequate appreciation of factors that influence social vulnerability in remote communities, and consequently, policy developed from it is likely to be ineffective.

Keywords: climate change; vulnerability; adaptation; Indigenous; Australia

1. Introduction

According to all the national-scale metrics, Australia is well positioned to combat the impacts of climate change, with the Intergovernmental Panel on Climate Change (IPCC) categorising it as having “high adaptive capacity” (Hennessy *et al.* 2007). Yet this national-level assessment masks a high level of sub-national heterogeneity. Australia is predominantly a relatively wealthy, urban society; however, remote northern Indigenous communities have been described as “fourth world” societies, with significant disparities between them and mainstream Australia clearly evident from most social and economic indicators (Carson *et al.* 2007). As such, many of the issues confronting these communities are far removed from those affecting urban-dwelling Indigenous and non-Indigenous Australians, particularly in relation to preparedness to confront the impacts of climate change.

This creates a challenge for Australian policy-makers working in the area of climate change. How can they incorporate the needs of these communities, whose concerns and priorities differ from those of the majority of the population? As a first step in exploring some of these issues, the Department of Climate Change and Energy Efficiency (DCCEE) commissioned a

*Corresponding author. Email: donna.green@unsw.edu.au

Scoping Study on the risks of climate change to remote Indigenous communities in the tropical north of Australia, from here on called the “Scoping Study” (Green *et al.* 2010).

This paper primarily discusses the Scoping Study’s findings, and in combination with interviews with stakeholders, the impact it had on relevant policy following its release in May 2010. The paper analyses the federal government’s approach to determining Indigenous vulnerability to climate impacts, and suggests how the government might reconsider reframing its approach in order to develop effective vulnerability reduction policies. Section 2 provides a concise background to the development of climate change vulnerability assessments, in order to contextualise the approach taken by the Scoping Study.

2. Climate vulnerability assessments

Vulnerability is a standard concept in the climate change literature. Its legitimacy is reinforced through its prominent position in the United Nations’ *Framework Convention on Climate Change*, and also in the ongoing IPCC assessments. Despite this prominence, its definition is not settled (Dow 1992, Brooks *et al.* 2005, Hinkel 2011). Much of this confusion can be traced to the concurrent evolution of vulnerability theory across different disciplines; from ecology, to political science, to hazard management (Adger 2006). This has resulted in multiple definitions and framings being interchangeably incorporated into the climate change literature, each with a different emphasis and objective (Hinkel 2011). This confusion has ramifications for policy because the ultimate choice of framing will influence how vulnerability is assessed, including the nature of the vulnerabilities explored. This, in turn, is likely to influence the prioritisation and hence resource allocation for potential adaptation activities and the type of adaptation activity undertaken (O’Brien *et al.* 2007).

There is a considerable amount of literature reviewing the numerous framings of vulnerability, and the merits of various assessment methods, so we do not intend to cover it in detail in this paper (see, for example, Adger 2006, Fünfgeld and McEvoy 2011, Hinkel 2011, Jones and Preston 2011). Given the Australian policy context, and the equity and broader socio-economic context associated with Indigenous vulnerability, we have chosen to explore two specific issues associated with assessing vulnerability. First, the use of “end-point” versus “starting-point” framings of vulnerability, and second, “top-down” versus “bottom-up” assessment methods.

2.1 Framing vulnerability: end point versus starting point

A framework first postulated in Kelly and Adger (2000) and then extended in O’Brien *et al.* (2004, 2007) classifies vulnerability into two categories: vulnerability as an end point, being the net impact of a given climate change scenario; and, vulnerability as a starting position, where it is considered to be a characteristic or state of a system generated by multiple social and environmental processes, which are themselves potentially exacerbated by climate impacts.

End-point framing, also described as “outcome vulnerability” (O’Brien *et al.* 2007), starts by identifying the biophysical impacts on a system from a set of greenhouse gas emission projections. The process then considers the system’s adaptive capacity with respect to these defined impacts. The residual consequence after adaptive capacity is considered as the system’s “vulnerability”. This highly linear approach does not easily accommodate broader socio-political considerations.

The second approach, starting-point analysis, embeds vulnerability in its present social context. By considering vulnerability as a starting point (or the “contextual vulnerability”), this framing is better able to explain the diversity of experiences, coping abilities and

resiliences in human systems observed at a national and sub-national level (O'Brien *et al.* 2004, 2007). Assessing vulnerability through this approach ultimately aims to reduce the impact of not only climate-related vulnerability, but also of the non-climate-related stressors affecting the system – recognising the dependencies and complexities of socio-ecological systems (Fünfgeld and McEvoy 2011), and is better positioned to create locally based adaptation solutions. It is also particularly important where vulnerability to climate change impacts is likely to be more determined not by exposure directly to biophysical impacts, but rather by other social and economic characteristics (Nelson *et al.* 2010).

2.2 Methodological approach: top-down versus bottom-up

Fundamentally linked to the discussion above, top-down methodologies used to measure vulnerability are often linked to “end-point” framings (Fünfgeld and McEvoy 2011). These processes take model output for larger geographic scales, often at quite large scales, and other quantitative data which are used as the primary inputs in impact assessments (Carter *et al.* 1994). Most useful for activities such as justifying mitigation efforts, rather than developing adaptation policy, these assessments generally provide aggregated assessments of climate change impacts, which are then used to determine vulnerability (Fussel 2007). This highly reductionist approach is not well suited for understanding the complex dynamics of socio-economic systems (Carter *et al.* 1994), nor is it able to incorporate the knowledge and concerns of affected populations (or if it does, this knowledge plays a very minor role in the assessment). Huq and Khan (2006) argue that the majority of the existing attempts to measure vulnerability are based on such a top-down methodology. The early IPCC reports included examples from such a top-down, impact assessment-type studies, in an attempt to delve into what the impacts of climate change might be (Jones and Preston 2011), and what areas would be more greatly affected (see, for example, Tegart *et al.* 1990).

A bottom-up approach, as the name suggests, inverts this assessment process. This approach encourages communities to assess and identify their own vulnerability and coping capacities, in order to produce recommendations grounded in the communities' reality. Fussel and Klein (2006) argue that this move reflects a change in informational needs, as the purpose of assessing vulnerability shifts from an impact assessment approach, to one that focuses more directly on developing adaptation strategies. The latter emphasis, they state, is far more grounded in the social determinants of vulnerability, and has a stronger emphasis on stakeholder involvement. This reasoning explicitly identifies that what makes one community vulnerable may have no bearing on the vulnerability of another, requiring locally grounded, flexible and responsive adaptation policy development (Brooks *et al.* 2005). The shift towards greater stakeholder inclusiveness is supported by the IPCC (Schneider *et al.* 2007, p. 804). A number of studies of Indigenous vulnerability in the Arctic adopt this format, which is able to incorporate traditional knowledge and resource-use patterns, and is flexible enough to look beyond vulnerability at inherent coping capacity within the societies drawing on historical experiences (see, for example, Berkes and Jolly 2001, Ford *et al.* 2006).

Although the need for more contextual, bottom-up exploration of vulnerability for the purpose of vulnerability reduction and adaptation is well established in the literature, there remains little practical methodological guidance on how to conduct such assessments (Fussel and Klein 2006, Hinkel 2011). Further, top-down, end-point-type analyses remain sought after by policy-makers as they provide quantitative justification for adopting particular policy options (Fünfgeld and McEvoy 2011); often favoured on account of being more transparent. This gap between what researchers say is needed, and what the policy-

makers are still seeking risks stagnating adaptation policy at a sub-national level in the information gathering and research phase, rather than moving towards developing practical vulnerability reduction activities, see Preston and Stafford-Smith (2009) and Fussler and Klein (2006) for further discussion of these issues.

For the reasons outlined above, in this paper we argue that the emphasis of any future Indigenous vulnerability assessment needs to shift to a contextual, bottom-up approach; one that incorporates an iterative process of adaptation policy development. As Indigenous Australians have clearly been identified as a group with specific needs in relation to climate change adaptation (NCCARF 2011), policies must be developed that explicitly address these needs.

3. Policy context

3.1 *The DCCEE*

The DCCEE is responsible for developing climate change policy in Australia. Its work is based on three core principles: reducing Australia's greenhouse gas emissions; adapting to the impacts of climate change; and helping to shape a global solution (DCCEE 2010a). This places adaptation on equal footing to mitigation in its portfolio, although this emphasis is a fairly new phenomenon.

The department was initially established to inform mitigation policy and to provide modelling results. Although now it is formally charged with adaptation policy, other than preparing guidance notes, providing grants, collating information and modelling work from other entities, the DCCEE's approach has been fairly reactive to date, with a notable lack of strategy and coordination. It has also demonstrated a tendency to shift responsibility for adaptation policy to state and local government levels (DCCEE 2010b). This tendency is not unique to Australia, and it is at the regional scale that climate impacts will most be felt. There is, however, a growing recognition that more is required from the federal level to support and co-ordinate the smaller-scale efforts – in terms of, for example, strategic oversight, ensuring equity in adaptation investment and capacity, and that projects and actions delivered across geographic or functional boundaries do not conflict (National Research Council 2010).

The work the DCCEE has performed on climate change vulnerability has primarily adopted the end-point definition. In terms of conducting its own review of national vulnerability, one of its major contributions to this area is a high-level risk assessment designed to assist in identifying vulnerabilities at the sub-national level (Allen Consulting Group 2005). However, as a high-level risk assessment, the document contained very little of the information required to support a contextual understanding of vulnerability.

3.2 *National-level climate policy*

The absence of leadership on adaptation policy at the national level is compounded by an absence of formal policy in this area. The 2005 document, *The National Climate Change Adaptation Framework* (from here on called the COAG Framework), prepared by the Council of Australian Governments (COAG 2006) sets priorities for adaptation planning, and it provides a loose timeline for these activities to be carried out. It discusses the need for each level of government to develop policies and strategies to assist in managing adaptation, and the need for high-level oversight. It also makes reference to an implementation plan, which was to detail roles and responsibilities of different levels of government, monitoring and evaluation that were to be completed in 2007. This document has not been released. This COAG Framework was the first high-level guidance on adaptation released

by the federal government. A more recent document, *Adapting to Climate Change in Australia. An Australian Government Position Paper* (DCCEE 2010b), has taken adaptation further: it has led to, for example, the establishment of the Coast and Climate Change Council, the National Climate Change Adaptation Research Framework, and support for the CSIRO Climate Adaptation Flagship. Most of these initiatives, however, relate to research priorities, rather than addressing the broader strategic role of the federal government in adaptation policy and planning.

There are two processes specifically relevant to assessing Indigenous vulnerability to climate change, both arising from the COAG Framework. The first is a component of the National Climate Change Adaptation Research Facility (NCCARF) and the second is the Scoping Study.

3.2.1 NCCARF

NCCARF's role includes developing National Adaptation Research Plans to identify critical gaps in the information available to decision-makers, synthesising research and establishing research networks. It breaks up research into eight different hubs. Two of these hubs are of direct relevance to Indigenous communities: those of human health and the social, economic, and institutional dimensions, and have either included small sections of the plan to identify this (e.g. in the human health plan) or commissioned research that impacts Indigenous communities (e.g. in both the human health plan and the social, economic, and institutional dimensions plan).

Indigenous communities did not at the outset of NCCARF have their own distinct hub, but were considered as a sub-category in some of the research plans – that is, Indigenous interests were mainstreamed within a Western-science-dominated framework (see, for example, the NCCARF *Adaptation Plan for Human Health*, McMichael *et al.* 2009). After vigorous lobbying from various groups, an update was made to the suite of hubs, and an Indigenous adaptation plan was included as part of an Indigenous hub. This addition to NCCARF's portfolio details an acknowledgement that there are specific issues and concerns relating to Indigenous Australians that necessitate a plan that is dedicated to them. It is worth mentioning that this plan is still in draft form – even though the NCCARF is four-fifths through its five-year life (Langton *et al.* 2011). Unsurprisingly, any research commissioned in response to this hub's draft plan's priority areas will not have the same depth or timeframe as research undertaken in a response to other hubs' plans. Indeed, in order to expedite the research funding for this hub, it was not possible to process the proposals through the normal NCCARF two-step procedure. Their timeframe for the research itself has also been circumscribed due to the late addition of this hub, which is particularly unfortunate given that research in Indigenous communities is particularly time intensive due to the need to ensure all the proper research protocols are met and that effective trust relationships are built between the community and the research team.

As the NCCARF initiative is primarily designed to point out research gaps, it is not resourced to provide significant funding to conduct research or to carry out project work itself. Each hub has had about \$2–3 million dollars to fund single year, or multi-year, projects that respond to the highest identified concerns that were developed as priority areas from the hub's plan. Given that only the highest priority areas are considered for funding rounds, and that of each of these areas, only one or at the most two projects received funding, it is reasonable to consider that a huge amount of essential adaptation research remains identified in the plans, but unfunded.

3.2.2 Risks from climate change to Indigenous communities in the tropical north of Australia, a Scoping Study

The terms of reference of this study included investigation of what is currently known about the impacts of climate change on Indigenous health, biodiversity (encompassing environment), transport and communication, education, and livelihoods on remote communities in the tropical north of Australia. The DCCEE's justification for commissioning this study is found in the COAG Framework, which specified that Australian governments would "conduct integrated assessments of the impacts of climate change on priority vulnerable regions, including... vulnerable Indigenous communities" (COAG 2006, p. 8). A more detailed discussion of the results of the Scoping Study is outlined in Section 6 of this paper.

The prescribed approach for this study was a top-down, end-point vulnerability-type framework, which considered changes and additional pressures to the *status quo* of pre-defined categories generalised across the study area. In order to attempt to expand on this approach and to incorporate more contextual information, the study's authors commissioned short case studies written, or co-authored, by Indigenous community leaders to be included in the document. This additional work was commissioned in order to provide a community perspective on vulnerability that otherwise would have been lacking in the report. Although not specifically in the terms of reference, the authors also included a discussion of the historical impacts of policy development on Indigenous culture and well-being to contextualise the discussion.

Neither of these DCCEE initiatives clarifies "what will happen next" with respect to developing adaptation responses to vulnerability assessments. Although the DCCEE commissioned the Scoping Study, discussions with staff members by one of this paper's authors suggest that the department ultimately divested responsibility for following through on any recommendations or research priorities that it highlighted. It appeared that the report was commissioned in order that a document could be presented to other federal and state departments, with the hope that these agents would take the initiative to respond to, and fund, the study's recommendations.

3.3 Indigenous policy

What originated as racism, and gradually evolved into paternalism, continues to shape Indigenous policy in Australia. This legacy has fuelled a failure to recognise the legitimacy of Indigenous culture (Maddox 1999), and the right of Indigenous people to genuinely participate in developing a vision for their own communities' future (AHRC 2009). This legacy has had a devastating impact on many communities, with a number of social indicators such as housing conditions, welfare dependence, health, and education standards still showing a significant gap between Indigenous and non-Indigenous Australians (SCRGSP 2007).

The government's efforts often mainstream Indigenous issues within broader processes, and tend to focus on top-down data gathering and assessment processes. The failure of adequate Indigenous participation, along with an emphasis on data collection, combined to challenge all levels of government with respect to developing new Indigenous policy that is inclusive and engaged.

The situation is not helped by the labyrinth of government departments involved in Indigenous affairs: multiple agencies at both the federal and the state level with overlapping jurisdictions encourage policy development that is frequently fragmented and uncoordinated (AHRC 2009). There is also a concern that such centralised agencies are too detached from the reality of the lives of Indigenous people living in remote communities to produce

effective policy for them. Yet it is against this backdrop that Indigenous policy on climate adaptation must be produced.

4. Document analysis and expert interviews

The data and information on which this paper is based were obtained through a series of 18 semi-structured interviews conducted in July and August 2009 conducted at the same time as extensive independent research into Australian Indigenous and climate change policy and relevant academic literature on climate change adaptation and vulnerability. The interviewees were selected based on their experience in climate impacts policy, vulnerability assessment, Indigenous rights or adaptation policy. They included individuals from all levels of government (state, federal, and local), several universities, and representatives from a number of prominent quasi-government agencies and NGOs. Depending on the interviewee's expertise, the questions asked related to the historical and current state of Indigenous policy in Australia, the application and their understanding of concepts of vulnerability and adaptation, and the direction of future climate change policy, both specifically and generally, in relation to adaptation planning for Indigenous communities.

These interviews were used to explore the limitations of the Australian policy response to climate change adaptation, as well as barriers to implementing successful Indigenous policy. The results were then incorporated into an analysis of the broader literature on climate change adaptation and vulnerability in order to identify key issues to be addressed in the near term to allow Indigenous adaptation policy to progress in an efficient, equitable, and effective manner.

5. The Scoping Study

The Scoping Study was one of the first attempts by the DCCEE to work closely with remote Indigenous communities and to begin to determine what climate change means to them, and to identify some of the challenges they might face from it. The study was only designed as a preliminary scoping exercise, to set the scene for a more comprehensive analysis. That comprehensive analysis has not yet been commissioned. In order to assess the value of the study, a summary of its findings are outlined below.

5.1 Community profile

The area of the Scoping Study had a very large proportion of land held under Aboriginal title, with thousands of clan estates and more than 130 language groups (Figure 1). In this region, the economy is dominated by sectors dependent on natural resources and the provision of government services. The majority of the Indigenous population in this region is much younger than the national average, leading to significant implications for the level and types of services they will need now, and in the future. Dispossession and loss of access to traditional lands, waters and natural resources, as well as a loss of ancestral, spiritual, totemic, and language connections to land and associated areas, are well documented for many of these communities. Together these factors comprise some of the non-climatic drivers that may hinder the adaptation process.

5.2 Climate projections

The temperature projections for northern Australia show the greatest warming over the north-west of the country, and lesser warming over the far north and north-east regions

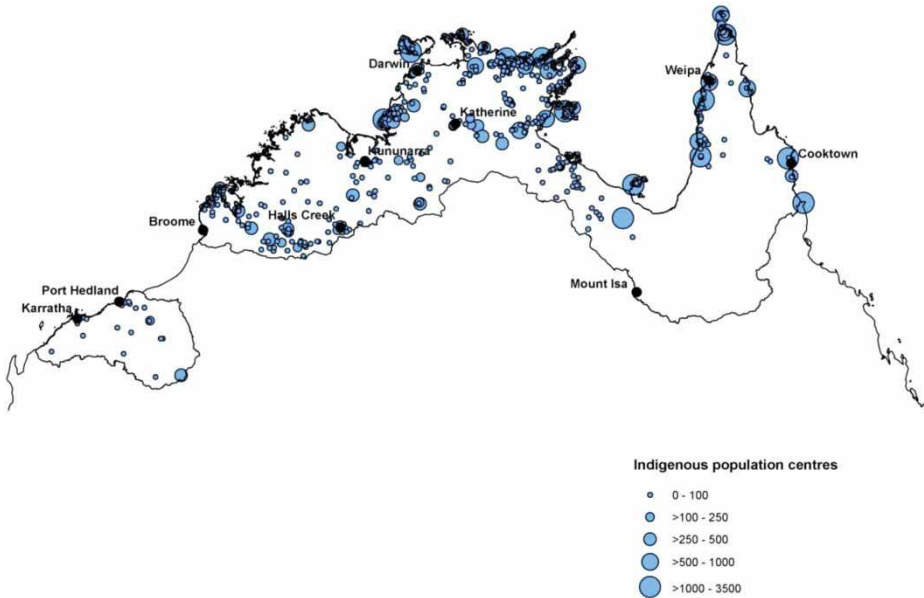


Figure 1. Indigenous community location and size.

(Green *et al.* 2010, p. 20). Average temperature increases are likely to cause an increase in temperature extremes: with hot spells – that is a run of sequential hot days and hot nights – projected to increase for much of this region (Green *et al.* 2010, p. 28).

Most precipitation in tropical north Australia is associated with the summer monsoon. Again, it is the increase in extremes for rainfall which is of most concern due to the potential for flooding causing health-related problems, transport difficulties, and in combination with an increase in the length of the dry season, changing environmental conditions for flora and fauna (Green *et al.* 2010).

Possible changes in evaporation in the tropical north are not discussed widely in the scientific literature. This is directly related to the uncertainty associated with precipitation and the Australian monsoon. Projections of sea surface temperatures near the tropical north of Australia indicate an increase of approximately 0.7°C by 2030, and by approximately 1.7°C by 2070 (Green *et al.* 2010, p. 25).

Sea-level rise in the tropical north is expected to be similar to the global average of at least 79 cm by 2100 (Green *et al.* 2010, p. 25). Sea-level rise will have the most significant impact in the short to medium term when it is combined with extreme events such as king tides. The case study section of the Scoping Study documents how some Indigenous communities are already very concerned about what climate impacts might mean for their ability to remain in their country because of coastal erosion and extreme weather events (Green *et al.* 2010, p. 120).

5.3 Impacts identified by Scoping Study

5.3.1 Health and well-being

The Indigenous view of health is holistic, relating the land and the community with the people – in stark contrast to that of Western philosophy, which places emphasis on the physical manifestation of disease in an individual (Braaf 1999, Green 2008, Ganesharajah

2009, HREOC 2009). Given Indigenous culture's unique relationship with land and sea country, it is hard for a non-Indigenous person to speculate as to the impact of climate change on Indigenous communities' health and well-being.

At the most superficial level, an immediate concern relates to these communities' natural resource dependence, that is their reliance on native plants and animals for food, medicine, and cultural purposes. Psychosocial health may also be affected if sacred sites are impacted, for example, if coastal sacred sites are eroded away or inundated.

A number of studies have shown that amongst Indigenous Australians, a good relationship to "country" and being able to fulfill "caring for country" obligations resulted in improved happiness and health (Ganesharajah 2009, HREOC 2009). The Scoping Study highlighted how relocation of Indigenous people from traditional homelands to larger regional centres has had a negative impact on their spiritual and social health, and has reduced opportunities for many people to participate in important cultural activities.

Climate change is also expected to elevate existing (and create new) physical health risks for Indigenous people. These include: increasing incidence of heat stress and dehydration, respiratory illnesses, and increasing transferability of diseases such as melioidosis. Compounding factors decrease Indigenous communities' adaptive capacity. These factors include poor nutrition, overcrowded housing, and lack of adequate water supplies, which are frequently found in these communities. Indirect impacts, such as reduction in bush food yields, disruption of fisheries, loss of livelihoods, and population displacement due to sea-level rise, are also clearly significant for the physical health of Indigenous people, although no quantitative analysis of these impacts has been undertaken till date.

5.3.2 *Transport and communication infrastructure*

The Scoping Study was unable to provide any level of detail about how climate change will impact on transport infrastructure for Indigenous communities in the study area. It suggested, however, that transport networks to, and between, larger regional centres and isolated communities are likely to be negatively affected by extreme weather, which will indirectly affect access to, and costs associated with, most goods and services.

Due to their isolation from large population centres, people living in remote Indigenous communities frequently experience difficulty in obtaining basic housing, sufficient basic service infrastructure, and other essential community services. The study indicated that climate change is likely to exacerbate these problems.

Climate change is also likely to make emergency evacuation by air more frequent (Green *et al.*, 2010, p. 48, Verland *et al.* 2011). The study noted that maintenance of airstrips is vital to ensure that patients can be transported from community clinics to regional hospitals via light aircraft, and other patients requiring less critical attention can be transported to regional centres when the community is isolated due to flooded roads.

The communication networks in remote communities located on or near the coast are likely to be impacted by more extreme weather events. The study suggests that repair or replacement costs of hardware will increase due to the difficulty and expense of the need to more frequently get goods and labour to remote areas.

The Internet is becoming a vital tool for Indigenous communities in the delivery of services, particularly for education and health. However, many communities in the study region do not have reliable access to the Internet or have mobile phone coverage. It remains to be seen whether the roll out of the National Broadband Network will be sufficient to improve necessary communications and emergency warning systems across the north.

5.3.3 Education

The Scoping Study found that there was very little information about the impacts of climate change on the delivery of education services in the study region. It did note that many communities already face significant difficulties in accessing adequate education services. Compounding these existing problems, major concerns from climate impacts relate to reduced access to schools due to more extreme weather, turnover of teachers unaccustomed to hotter conditions, and the ability of students to concentrate on hot days (Dapi *et al.* 2010, Green *et al.* 2010, p. 64). The distance to education facilities for secondary school students is already a significant problem in many communities. Climate change is likely to reduce access to larger towns and, therefore, is likely to cause additional difficulties in this respect (Green *et al.* 2010, p. 64). The study suggested that future planning for education infrastructure should take into account the location of buildings, preferably outside flood plain areas and away from coasts vulnerable to storm surges.

5.3.4 Livelihood

Significant areas of the north are managed by Indigenous Australians and consequently they will have a disproportionately larger role to play in maintaining ecosystem services and biodiversity in these regions. While climate change is expected to impact negatively on natural resources and related industries, there are some economic opportunities arising from the need to better manage and, in some cases restore, ecosystems for biodiversity conservation.

The economies of many remote Indigenous communities are reliant on a non-market or “customary” sector. This sector interacts with markets and the state so that where the customary sector is overlooked, policy prescriptions are likely to be inappropriate or ineffective.

This hybrid economy is highly reliant on access to natural resources, and so will be profoundly affected by climate change. It is likely that customary reliance on wildlife by Indigenous communities will be interrupted by changing seasonal patterns of availability, and the decline, or disappearance, of some species.

Indigenous enterprises and employment in tourism, recreational fishing and hunting will face pressure as they are highly dependent on the ability of visitors to travel to remote regions of northern Australia. Indirect impacts on enterprises producing commodities for sale were not quantified in the study; however, it is likely that there will be increased transport costs associated with getting goods to market.

There are numerous opportunities for Indigenous people to engage with and manage landscape health through the expansion of ranger or other land-management programmes to manage invasive species, monitor environmental change, and revegetate degraded land. The benefits of greater Indigenous engagement extend beyond increasing employment opportunities; they can lead to increased connection to country and strengthened cultural practice. The traditional knowledge of Indigenous Australians is a valuable base from which Western scientists and resource managers may be able to learn more about how species are likely to respond to climate change.

6. Moving beyond the limitations of the current approach

The Scoping Study begins the process of identifying the complexity of Indigenous vulnerability to climate impacts in northern Australia. However, due to its prescribed approach, it is somewhat limited in its ability to prioritise factors that affect vulnerability from an

Indigenous communities' perspective; or, to assist in developing vulnerability reduction policies that incorporate local contexts and resiliences. Although the case studies presented in the Scoping Study help somewhat in redressing this issue, there is a constraint in community "ownership" of any climate adaptation policy that is developed with such a limited engagement of the communities themselves. In addition, without fully reflecting the specific social and economic situations of these communities, it is likely that any policy will inadequately incorporate the interactions between multiple stressors that will impact these regions over the coming decades.

Reinforcing the need for a more contextual understanding of Indigenous vulnerability, the Scoping Study is specific to Indigenous communities in northern Australia and its findings cannot be taken to apply across all Indigenous communities nationally. It demonstrates that vulnerability is closely linked to the existing policy challenges in the north, which are associated with national "closing the gap" policy targets relating to health, housing, education, and employment. The extent of this link may not be as relevant in Indigenous communities elsewhere; a national approach to Indigenous vulnerability must be capable of incorporating the varying needs and priorities of different communities around the country.

The Scoping Study recommends that adaptation strategies need to be formulated to support general adaptive capacity to a variety of uncertain futures. Concurring with the IPCC, the Scoping Study suggests these strategies should occur in an iterative manner (Schneider *et al.* 2007, p. 804), a recommendation intended to avoid delaying action while further precision in defining current vulnerability is obtained. This iterative approach would integrate the existing vulnerability assessment and adaptation activities, to ensure ongoing learning and readjustment, as our understanding of vulnerability and adaptation, and as our knowledge of climate change consequences and how they will interact with other trends, evolves.

The results of the Scoping Study, in particular the need for an iterative and contextual understanding of adaptation, reinforced the broader research findings. During the course of the research, many different factors were identified as potentially or actually limiting progress on Indigenous adaptation – for example, concern over the use of metrics that only painted a picture of economic disadvantage, a tendency for policy to be driven by a narrative of hopelessness which overlooks Indigenous resilience, lack of adequate communication of climate science, an emphasis on too much top-down data collection, and mainstreaming Indigenous adaptation within broader non-Indigenous processes. Although seemingly unrelated, a closer examination revealed that many of these resulted from a failure to incorporate the following three elements into work on Indigenous vulnerability:

- (1) Placing the uncertainty of climate projections at the heart of adaptation actions.
- (2) Requiring meaningful and appropriate consultation with Indigenous communities.
- (3) Basing assessment upon an evolving contextual and non-standardised framing of local vulnerability.

We note that these elements are fundamentally important for good adaptation policy more generally; however, they take on a particular relevance and importance in the context of remote Indigenous communities. This is discussed further below.

6.1 Working with uncertainty

For many policy issues, even the best scientific knowledge can still be incomplete (Brunner *et al.* 2005). This applies to many areas involving environment–human interactions, and is

particularly the case for climate policy. The inherent complexity of human–environment systems, unpredictable due to their nonlinearity and open nature, means generating accurate predictions becomes impossible (Nelson *et al.* 2008). Yet research directives in the climate change arena continue to emphasise the need for a more accurate and precise modelling upon which to base decisions (see, for example, DCC 2009). This information is then used to produce a single, “optimal” adaptation solution, considered indispensable for adaptation decision-making (Dessai *et al.* 2009).

Many researchers and practitioners are now questioning the benefit of such a focus. As discussed by Dessai *et al.* (2009), such dependence leaves policy decisions vulnerable to errors in the modelling – which are almost certain to occur given the cascading uncertainties in integrated climate assessments. This shift in thinking is consistent with trends in other fields highly exposed to decisions based on uncertain future events, such as monetary policy (see, for example, Orphanides and Williams 2007, p. 4).

Dessai *et al.* (2009) advocate seeking robust solutions that hold over a large range of future climate scenarios. In this case, having more precise future projections is not necessarily beneficial to the decision-making process. This option explicitly recognises the uncertainties associated with modelling, and uses model output as a decision aid, rather than a prescription, to explore the dependence. It presents a way to break the cycle of data gathering, to proceed to develop policy without complete knowledge. It is this sort of flexibility and creativity that need to be demonstrated by policy-makers in this area. Such an approach would allow a selection of options that are flexible enough to fit multiple futures, and do not preclude future options (Adger *et al.* 2009).

The Scoping Study identified that many Indigenous people want to understand the impacts of climate change from a non-Indigenous perspective. This necessarily requires discussion of the uncertainty of future impacts, and the implications of this uncertainty, which must be clearly and comprehensively discussed with the communities in question. Recent work on the use of scenarios in adaptation planning could assist this process (see, for example, Wiseman *et al.* 2011). Careful and collaborative construction and use of scenarios could have many benefits: it could promote relationship building and trust between the Indigenous community and researchers/practitioners, allow the impact of uncertainty to be explored, and incorporate other broader social and economic issues facing Indigenous communities. The results could be used as a means of collaboratively devising and exploring the implications of robust adaptation actions.

6.2 Community engagement

Just as the communication and express acknowledgment of uncertainty is essential to adaptation policy, so too is meaningful community engagement. The extent and nature of the engagement with remote Indigenous communities, however, require a slightly different emphasis, due to the presence of additional issues such as a lack of trust, and differences in culture and worldview.

Meaningful stakeholder participation is vital to obtain a contextual understanding of a specific situation (Clark 2002). Such consultation becomes even more important when dealing with marginalised groups (Huq & Khan 2006), and therefore takes on great significance for remote Indigenous communities. It was noted a number of times during interviews, and is reconfirmed by much of the literature on this topic, that there has been a general failure to engage Indigenous communities in climate change research in Australia (Hennessy *et al.* 2007, HREOC 2009). For example, as noted in several interviewees, the high-level national-level vulnerability assessment commissioned by the federal

government, although discussing the impact of climate change on remote Indigenous communities, had no direct Indigenous engagement, and only limited engagement with bureaucrats from departments handling Indigenous affairs (see Allen Consulting Group 2004). Several of the Indigenous researchers interviewed about this issue commented that they considered the consultation process over climate impacts had been “tokenistic” to date.

Aside from the procedural justice and trust implications of the failure to properly consult, there are a number of serious consequences of inadequate consultation. Linked to the difference in world views previously described, failure to include the Indigenous community directly in discussions relating to vulnerability assessment means that the policy-makers will make (possibly incorrect) assumptions about community priorities and values. An example of this problem can be seen in the decision to limit financial resources and infrastructural support to outstations in the Northern Territory. There are many documented health and social benefits for Indigenous communities living in outstations, and consequently they are the location of choice for many Indigenous families keen to maintain their links with their country and their culture (Altman 2006). Yet due to a failure to properly consult with the relevant communities, a centralist policy was developed which assumed that a greater integration is a necessary and an inevitable step for Indigenous community viability.

It is likely that until meaningful consultations between community leaders and decision-makers take place, policy-makers will develop and impose adaptation strategies that will have little connection with community aspirations or adequately incorporate differences in world view and culture. This approach not only reinforces Indigenous Australians’ marginalisation, but it also further disempowers them, thereby increasing their social vulnerability.

As the Human Rights and Equal Opportunity Commission (HREOC 2009) notes, climate change impacts a community’s ability to “care for country”, and will therefore need to be factored into adaptation decisions. This, and the inclusion of other contextual and culturally specific considerations, can only occur through a policy approach that is inclusive and collaborative, in which Indigenous people and their organisations are primary players. As suggested earlier, this process will need to go beyond standard consultation processes, with an increased emphasis on initial relationship and trust building. This will need to be followed up with an in-depth exploration of the relevant aspects of Indigenous culture and worldview, and their implications.

The Scoping Study’s recommendations clearly indicate the need to root this process firmly in the community (Appendices 1 and 2 of this paper reproduce the Scoping Study’s recommendations). Importantly, many Indigenous communities and organisations recognise the need to be proactive in responding to climate change threats and also finding solutions that arise from the community itself. However, such a process is not guaranteed; particularly if, as was intimated in interviews with bureaucrats, the recommendations are merely put before other government departments for action, rather than comprehensively integrated into a long-term, multi-level adaptation strategy.

6.3 Reframing vulnerability

The least understood kind of vulnerability is that of social vulnerability (Cutter *et al.* 2003). Yet reducing vulnerability to climate change, and developing adaptation actions, requires a deep understanding of the relevant social dimensions (Hinkel 2011). Given the very complex social context and conditions experienced by remote Indigenous communities, this takes on additional importance.

There have been a number of attempts to measure vulnerability using discrete metrics (see Eriksen and Kelly 2007 for a more complete discussion). Despite this, one of the most common conclusions drawn from academic research is how inherently complex the concept is, with each additional study teasing out further connections and contextual dependencies (Eriksen and Kelly 2007). For example, poverty is considered to be a “generic” determinant of vulnerability in that it is “likely to influence vulnerability to a wide variety of hazards in different geographical and socio-political contexts” (Brooks *et al.* 2005, p. 153). As such, there is little doubt that economic marginalisation is a significant factor (Blaikie *et al.* 1994); however, it is how economic marginalisation interacts with other factors at the local level that creates a true picture of social vulnerability (Brooks *et al.* 2005).

There was concern amongst some academics interviewed that a vulnerability assessment of Indigenous Australians would reproduce a map of socio-economic disadvantage, with much of the inherent resilience of Indigenous communities masked by emphasis on standard socio-economic metrics. An example supporting the more subtle nature of Indigenous resilience is demonstrated in one of the Scoping Study’s case studies, which describes a situation where after a natural disaster, the affected Indigenous community recovered far more quickly than the local non-Indigenous community (Green *et al.* 2010, p. 99). An oversimplified approach to assessing vulnerability would have failed to capture this unexpected element of the community’s adaptive capacity.

To attach the label “vulnerable” to a community due to the presence of a factor such as economic marginalisation, without deeper analysis of the inbuilt coping strategies and resilience, can potentially further disempower that community (Ellemor 2005, Thomas and Twyman 2005). It carries implications of weakness, passivity and instability and, as such, “resiliences become invisible and the vulnerable entity is often identified as the problem” (Campbell 2003, p. 9 cited in Ellemor 2005, p. 3). This is particularly true in the Indigenous context, where such a discourse of powerlessness and vulnerability has historically been used to justify “externally imposed changes” (Ellemor 2005, p. 3).

Such oversimplification is likely to affirm the negative perception of Indigenous communities held by many non-Indigenous Australians, by locating responsibility for the problems “within the vulnerable entity, rather than by examining the broader underlying processes that place these communities at risk” (Campbell 2003 cited in Ellemor 2005, p. 3). It also fails to acknowledge the complexity of coping mechanisms that are deeply entrenched in their society, developed over thousands of years living in highly variable climates.

Effective adaptation responses must be developed around a framing of vulnerability that is truly contextual, and able to incorporate broader social and economic factors. This cannot be provided by assessments based on standardised metrics. Instead, initial work on Indigenous vulnerability should seek an understanding of the values of relevant stakeholders, broader links with other systems and stressors, and the communities’ own inherent strengths and weaknesses.

Moving beyond the framing of vulnerability used, the work must also acknowledge that this understanding of vulnerability can never be “complete” – vulnerability is a dynamic state, as are the various factors that influence it. This is done through action not being delayed because of incomplete knowledge. Instead, as recommended in the Scoping Study, what is known should be incorporated into an iterative process of assessing vulnerability and developing adaptation actions, with an emphasis on flexibility and on-going learning and reassessment.

Adaptation is likely to mean different things to Indigenous people; their unique social, cultural, and economic context means any adaptation goals and implications cannot be

assumed in advance. A process designed to elucidate these differences cannot begin to address their substance until the three elements described above have been addressed. Furthermore, these three elements are increasingly being identified in the literature as a key to effective adaptation. Despite this, actual government policy on Indigenous adaptation has yet to adequately acknowledge or incorporate them.

To facilitate this shift and to remedy the lag between vulnerability research and policy, the federal government needs to push forward with an Indigenous adaptation strategy, including vulnerability assessments and adaptation planning as described above, in a more proactive and strategic manner, simultaneously decreasing its current emphasis on top-down data gathering. Responsibilities need to be clarified both within the federal government, and between different levels of government to ensure policies to facilitate adaptation of Indigenous communities do not slip “between the gaps”; goals need to be defined and communities need to be engaged and actively incorporated into these processes from the outset.

7. New policy directions

A number of other significant events have contributed towards understanding Climate Change and Indigenous people’s needs – including the International Expert Group Meeting on Indigenous Peoples and Climate Change, Darwin, 2008; and the Indigenous Peoples, Marginalized Populations and Climate Change meeting, Mexico, 2011, which both identified the growing urgency to take action. In the year since the release of the Scoping Study, the federal government has not engaged in any significant discussion about how to incorporate the findings or recommendations of this report into their various departments’ operations or planning.

8. Conclusion

The Scoping Study begins to demonstrate the complex nature of Indigenous vulnerability to climate change. However, any approach based on this assessment alone is insufficiently complex to allow a full appreciation of the dynamic interplay of factors that influence social vulnerability in remote Indigenous communities, often collecting data that is not particularly useful to inform adaptation strategies.

Nor is the current tendency to “mainstream” Indigenous vulnerability to climate change appropriate. Exploring Indigenous vulnerability within the existing assessment framework is unlikely to provide necessary insights to produce effective adaptation policy, due to its lack of meaningful engagement with Indigenous communities and consequent lack of contextually specific information. The creation of an Indigenous hub as part of the NCCARF process is a good start, but, given its late inclusion and the lack of progress, it again risks being considered as tokenistic.

Indigenous people’s involvement in decisions affecting them and their culture still struggles to be meaningfully recognised in policy development in Australia. Attempts to change this have not yet been broadly successful. Decision-makers’ ability to incorporate different worldviews and cultures is constrained by society’s values and institutional structure: they struggle to co-ordinate on issues that span different government departments, and that raise considerations that do not fit neatly into the existing categories.

Climate change policy presents many similar problems to Indigenous policy, in that it spans different departmental areas, knowledge, and value systems. Academic understanding of vulnerability is forming an increasingly complex picture – incorporating the

importance of the local context, the uncertainty of future climate predictions, and the interaction between multiple stressors. Translating this knowledge into assessments that can be used to develop effective adaptation strategies is proving to be more elusive; historical attempts to measure it are overly simplistic. We propose instead that Indigenous vulnerability and its assessment must be tackled through a dedicated strategy that is designed to meet their specific cultural needs – mainstreaming Indigenous issues has led to failure in many other contexts, and the analysis here indicates there is no reason to believe this situation would be any more successful.

Any targeted Indigenous data gathering or research should generate the information required to produce both vulnerability assessments and adaptation policy that are relevant to the needs and worldview of remote Indigenous communities. That is, collecting information on how best to work with communities to identify vulnerabilities, capacities, capture local knowledge, and integrate it meaningfully with scientific knowledge. It should consider how to build on the communities' strengths whilst working out how best to address vulnerabilities, centering the decision-making process within the community itself. In conducting this work, and to avoid the mistakes of previous work with Indigenous communities, the highest ethical standards must be followed. In addition, separate and targeted communication requirements must be established, to recognise the different cultural contexts, and outcomes must be designed for uptake by the relevant Indigenous community.

Given the reality that the uncertainties of climate change are unlikely to be resolved in a time frame relevant to decision-makers, adaptation must begin even in the absence of complete information. This requires any strategy to recognise the dynamic interplay between vulnerability assessments and any adaptation policies flowing from them. Both need to be continuously monitored and reviewed – vulnerability and resilience are not static concepts, and activities should (where possible) be based on adaptive-management approaches as knowledge of the broader context evolves. The lessons learnt from any adaptation interventions must be disseminated broadly in both narrative form and using appropriate metrics, to ensure their contextuality is not lost.

The commissioning of an independent Scoping Study outside NCCARF was a good first step to achieving this. However, now this study is complete, DCCEE needs to take responsibility for working with relevant government departments and Indigenous communities to implement the report's recommendations. It is only by working with communities, building trust, and avoiding the mistakes of past policies, that communities can be assisted in tackling future challenges. This requires federal government leadership and, within this, the exact role of the DCCEE must be defined. It must be given the resources and support from the highest levels of leadership to ensure that it can carry out this mandate, and garner the support of other departments and levels of government without encountering either territorial disputes or having its authority questioned.

Without this leadership and a clear strategy, it will be a struggle for federal, state, or territory governments to produce vulnerability assessments, and consequently develop adaptation policies that are genuinely relevant to the needs of remote Indigenous communities.

Although this policy area is still evolving, the equity and social justice issues of adaptation policy are starting to come to the fore at the sub-national level, particularly in relation to Indigenous and marginalised populations who are expected to suffer disproportionately from the impacts of climate change. To minimise this burden, Indigenous adaptation must be addressed in a timely and effective manner, and in a way that does not repeat the policy failings of the past.

References

- Adger, N., 2006. Vulnerability. *Global Environmental Change*, 16 (3), 268–281.
- Adger, N., *et al.*, 2009. Are there social limits to adaptation to climate change? *Climatic Change*, 93 (3–4), 335–354.
- AHRC, 2009. *Our future in our hands – creating a sustainable National Representative Body for Aboriginal and Torres Strait Islander peoples*. Report of the Steering Committee for the creation of a new National Representative Body 2009.
- Allen Consulting Group, 2004. *Climate change risk and vulnerability: working paper: summary of stakeholder views in consultation*. Report to the Australian Greenhouse Office, Department of the Environment and Heritage.
- Allen Consulting Group, 2005. *Climate change risk and vulnerability: promoting an efficient adaptation response in Australia*. Report to the Australian Greenhouse Office, Department of the Environment and Heritage.
- Altman, J., 2006. *In search of an outstations policy for Indigenous Australians*. Centre for Aboriginal Economic Policy Research, Australian National University, Working Paper No. 34/2006.
- Berkes, F. and Jolly, D., 2001. Adapting to climate change: social–ecological resilience in a Canadian western Arctic community. *Conservation Ecology*, 5 (2), 18–32.
- Blaikie, P., *et al.*, 1994. *At risk: natural hazards, people's vulnerability and disasters*. London: Routledge.
- Braaf, R., 1999. Improving impact assessment methods: climate change and the health of indigenous Australians. *Global Environmental Change*, 9 (2), 95–104.
- Brooks, N., Adger, N., and Kelly, P., 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change*, 15 (2), 151–163.
- Brunner, R., *et al.*, 2005. *Adaptive governance: integrating science, policy, and decision making*. New York: Columbia University Press.
- Campbell, J., 2003. Geography, vulnerability and nature. Paper presented at the *New Zealand Geographical Society Annual Conference*, Auckland, July 6–11, 2003.
- Carson, B., *et al.*, eds., 2007. *Social determinants of indigenous health*. Sydney: Allen & Unwin.
- Carter, T., *et al.*, 1994. *IPPC technical guidelines for assessing climate change impacts and adaptations*. Working Group II of the Intergovernmental Panel on Climate Change. London: University College London (UK) and Center for Global Environmental Research (Japan).
- Clark, T., 2002. *The policy process: a practical guide for natural resources professionals*. New Haven, CT: Yale University Press.
- COAG, 2006. *National climate change adaptation framework [online]*. Council of Australian Governments. Available from: <http://www.climatechange.gov.au/government/initiatives/national-climate-change-adaptation-framework.aspx> [Accessed 1 December 2010].
- Cutter, S., Boruff, B., and Shirley, W., 2003. Social vulnerability to environmental hazards. *Social Science Quarterly*, 84 (2), 242–261.
- Dapi, L., *et al.*, 2010. Heat impact on schoolchildren in Cameroon, Africa: potential health threat from climate change. *Global Health Action*, 3, 3610.
- DCC, 2009. *Australian climate change science: a national framework*. Canberra: DCC.
- DCCEE, 2010a. *About us [online]*. Canberra: DCCEE. Available from: <http://climatechange.gov.au/about.aspx> [Accessed 10 November 2011].
- DCCEE, 2010b. *Adapting to climate change in Australia*. An Australian Government Position Paper. Canberra: DCCEE.
- Dessai, S., *et al.*, 2009. Climate prediction: a limit to adaptation? *In*: N. Adger, I. Lorenzoni and K. O'Brien, eds. *Adapting to climate change: thresholds, values, governance*. Cambridge: Cambridge University Press, 49–57.
- Dow, K., 1992. Exploring differences in our common future(s): the meaning of vulnerability to global environmental change. *Geoforum*, 23 (3), 117–136.
- Ellemor, H., 2005. Reconsidering emergency management and indigenous communities in Australia. *Environmental Hazards*, 6 (1), 1–7.
- Eriksen, S. and Kelly, P., 2007. Developing credible vulnerability indicators for climate adaptation policy assessment. *Mitigation and Adaptation Strategies for Global Change*, 12 (4), 495–524.
- Ford, J., *et al.*, 2006. Vulnerability to climate change in Igloodik, Nunavut: what we can learn from the past and present. *Polar Record*, 42 (221), 127–138.

- Fünfgeld, H. and McEvoy, D., 2011. *Framing climate change adaptation in policy and practice*. Working Paper 1, Framing Adaptation in the Victorian Context Project. Melbourne, Victorian Centre for Climate Change Adaptation Research, and RMIT University Climate Change Adaptation Program.
- Fussel, H., 2007. Vulnerability: a generally applicable conceptual framework for climate change research. *Global Environmental Change*, 17 (2), 155–167.
- Fussel, H. and Klein, R., 2006. Climate change vulnerability assessments: an evolution of conceptual thinking. *Climate Change*, 75 (3), 301–329.
- Ganesharajah, C., 2009. *Indigenous health and wellbeing: the importance of country*. Native Title Research Report No. 1/2009, Native Title Research Unit, Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra Australia.
- Green, D., 2008. *Climate impacts on the health of remote Northern Australian Indigenous communities*. Report prepared for the Garnaut Climate Change Review.
- Green, D., Jackson, S. and Morrison, J., eds., 2010. *Risks from climate change to indigenous communities in the Tropical North of Australia: a scoping study for the Commonwealth department of climate change*. Canberra: Department of Climate Change.
- Hennessy, K., et al., 2007. Contribution of working group II to the fourth assessment report of the inter-governmental panel on climate change. In: M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds. *Australia and New Zealand. Climate change 2007: impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press, 507–540.
- Hinkel, J., 2011. Indicators of vulnerability and adaptive capacity: towards a clarification of the science–policy interface. *Global Environmental Change*, 21 (1), 198–208.
- HREOC, 2009. *Report of the Aboriginal and Torres Strait Islander Social Justice Commissioner*. Australian Human Rights Commission 2009.
- Huq, S. and Khan, R., 2006. Equity in national adaptation programs of action (NAPAs): the case of Bangladesh. In: N. Adger, J. Paavola and S. Huq, eds. *Fairness in adaptation to climate change*. Massachusetts: MIT Press, 181–200.
- Jones, R.N. and Preston, B.L., 2011. Adaptation and risk management. *Wiley Interdisciplinary Reviews: Climate Change*, 2 (2), 296–308.
- Kelly, P. and Adger, W., 2000. Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*, 47 (4), 325–352.
- Langton, M., et al., 2011. *National climate change adaptation research plan: indigenous communities*. 26th September 2011 draft. (NCCARF: Griffith).
- Maddox, M., 1999. *Indigenous religion in secular Australia* [online]. Research Paper 11. Australian Government, Canberra. Available from: <http://www.aph.gov.au/library/pubs/rp/1999-2000/2000rp11.htm> [Accessed 10 December 2010].
- McMichael, A., et al., 2009. *National climate change adaptation research plan for human health*. Australia: National Climate Change Adaptation Research Facility, Gold Coast.
- NCCARF, 2011. *National adaptation research plans*. Available from: <http://www.nccarf.edu.au/national-adaptation-research-plans> [Accessed 23 November 2011].
- National Research Council, 2010. *America's climate choices: panel on adapting to the impacts of climate change*. Washington, DC: National Academies Press.
- Nelson, R., Howden, M., and Stafford-Smith, M., 2008. Using adaptive governance to rethink the way science supports Australian drought policy. *Environmental Science and Policy*, 11 (7), 588–601.
- Nelson, R., et al., 2010. The vulnerability of Australian rural communities to climate variability and change: Part I – conceptualising and measuring vulnerability. *Environmental Science and Policy*, 13 (1), 8–17.
- O'Brien, K., et al., 2004. *What's in a word? Conflicting interpretations of vulnerability in climate change research*. CICERO Working Paper #4.
- O'Brien, K., et al., 2007. Why different interpretations matter in climate change discourses. *Climate Policy*, 7 (1), 73–88.
- Orphanides, A. and Williams, J., 2007. *Robust monetary policy with imperfect knowledge*. Working Paper Series 2007-08, Federal Reserve Bank of San Francisco.
- Preston, B. and Stafford-Smith, M., 2009. *Framing vulnerability and adaptive capacity assessment*. Discussion paper. CSIRO Climate Adaptation Flagship working paper #2.
- Schneider, S., et al., 2007. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In: M. Parry, O. Canziani, J. Palutikof, P. van der Linden and C. Hanson, eds. *Assessing key vulnerabilities and the risk from climate change*.

- Climate change 2007: impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press, 779–810.
- SCRGSP, 2007. *Overcoming Indigenous disadvantage: key indicators 2007* [online]. Steering Committee for the Review of Government Service Provision. Productivity Commission, Canberra. Available from: <http://www.pc.gov.au/gsp/reports/indigenous/keyindicators2007> [Accessed 10 December 2010].
- Tegart, W.J.McG., Sheldon, G.W., and Griffiths, D.C., eds., 1990. *Climate change: the IPCC impacts assessment*. Report prepared for Intergovernmental Panel on Climate Change by Working Group II, Australian Government Publishing Service, Canberra, Australia, 294.
- Thomas, D. and Twyman, C., 2005. Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environmental Change*, 15 (2), 115–124.
- Verland, S., Howitt, R., and Dominey-Howes, D., 2011. Invisible institutions in emergencies: evacuating the remote Indigenous community of Waruwi, Northern Territory Australia for cyclone Monica. *Environmental Hazards*, 9 (2), 197–214.
- Wiseman, J., et al., 2011. *Scenarios for climate adaptation: final report*. Victorian Centre for Climate Change Adaptation Research, 192.

Appendix 1. Overarching scoping study report recommendations

There is an urgent need to engage with Indigenous communities on matters associated with climate change for communication purposes as well as the development of collaborative activities.

To host a northern summit on climate change related matters hosted by an Indigenous institution. Such a summit would:

- Present the most recent knowledge associated with climate change directly to an Indigenous audience.
- Allow Indigenous people to present climate change perspectives and adaptation strategies from a community-based approach.
- Allow the Federal, State and Territory, and Local governments to be engaged in partnership with communities.
- Develop community-based strategies and engagement methodologies to foster best practice approaches.
- Conduct long-standing research partnerships.

There is a need to develop a climate change clearinghouse in collaboration with Indigenous institutions.

Establish a clearinghouse that provides services to:

- Boost the communication capacity between remote Indigenous communities and the scientific community.
- Articulate community-based initiatives to share knowledge and experiences relating to climate change.
- Support the development of Indigenous climate change strategies through partnerships with institutions and experts.

Little attention has been given to the topic of Indigenous vulnerability to climate change in northern Australia by the research sector to date.

To develop well-articulated adaptation strategies for Indigenous people in the tropical north requires new collaborations, dedicated resources, and partnerships. The first step, prior to the development of such strategies, would be to conduct an in-depth collaborative study to explore the following:

- (a) Current determinants of vulnerability in a number of communities in northern Australia.
- (b) The current adaptive capacity within these Indigenous communities.
- (c) Opportunities for enhancing this adaptive capacity.
- (d) Future scenarios to determine what actions would improve the resilience of a number of sectors, for instance health, tourism, agriculture, natural resource management and education within and outside of Indigenous communities.

All of the National Climate Change Adaptation Research Facility's Networks should be encouraged to integrate Indigenous interests into their respective research programmes.

The literature to date on vulnerability of many of these communities to climate change is in dire need of more in-depth and empirical research. Moreover, in appreciating that "one size will not fit all" with regards to developing resilience and adaptation strategies for these communities, it would be recommended that a number of regionally specific, in-depth studies be conducted. It is expected that by adopting such a regionally specific approach, the varying needs of remote communities would be captured. In addition, Indigenous communities should be consulted and fully engaged in climate change studies and associated decisions concerning their communities.

Appendix 2. Scoping study recommendations by sector

A1. Health

Climate change is expected to elevate the health risks for Indigenous people in the north.

Anticipatory adaptation activities to reduce the impact of these risks are likely to lead to improvements to health more generally. Health strategies should include potential impacts from climate change, such as vector-borne diseases, heat-related illness, and psycho-social health. Policies need to be implemented to reduce the range of factors that are frequently found in Indigenous communities, such as poor nutrition, overcrowded housing, lack of adequate water supplies – all of which serve to reduce adaptive capacity.

A2. Biodiversity

Dispossession and loss of access to traditional lands, waters and natural resources as well as a loss of ancestral, spiritual, totemic, and language connections to lands are a major documented concern which have made Indigenous people more vulnerable to the effects of climate change.

Encouraging restitution of environmentally beneficial relationships with the land may contribute to reducing the vast differences in social outcomes between Indigenous and non-Indigenous Australians, and in greatly enhancing the adaptive capacity of Indigenous Australians. Climate change adaptation planning must take the negative historical experience of relocation of Indigenous people from their country into account.

A3. Infrastructure

Transport and communication infrastructure is already extremely limited in many parts of the study region, climate change is expected to place further strain on these limited services.

Improving key access points, raising new and existing building standards against the impacts of extreme weather, and enhancing resilience of locally sourced energy and maintenance systems are critical investments that could also create employment for local Indigenous people. More generally, studies need to be carried out so priority areas can be identified and appropriate planning mechanisms developed.

Overcrowding and inappropriate building stock in many Indigenous communities may increase vulnerability to climate change, particularly if cyclones increase in intensity.

New buildings designed for remote Indigenous communities in northern Australia should take account of passive design, and energy and water efficiency principles. Dedicated community-based cyclone shelters need to be constructed in cyclone-prone areas and they should take into account cultural avoidance protocols.

Sea-level rise will have the most significant impact in the short to medium term when it is combined with extreme events such as king tides and storm surges.

The vulnerability of communities to sea-level rise, storm surge, etc. requires further research across the north. Working with the existing programmes, vulnerable communities need to be identified and prioritised. New data may need to be collected and compiled to carry out this activity.

A4. Education

While there is generally low public awareness about the potential impacts of climate change, it is likely that this is an even greater problem for Indigenous Australians owing to the recognised challenges of current forms of formal educational systems, remoteness and lack of appropriate educational materials.

Education could play an important role in enhancing the adaptive capacity of northern communities. However, there is a need to develop policies that enable and empower Indigenous communities to respond accordingly to climate change in a manner that supports local laws, language, and customs. Maintenance of cultural practices to provide people with livelihoods and strengthen their resilience to future change is vital. Indigenous knowledge is a valuable but shrinking base from which Western scientists may be able to learn more about how the environment could respond to climate change, and projects that engage with both forms of knowledge should be supported.

A5. Livelihood

Climate change will affect the “natural” environment, with major flow-on implications for remote communities dependent on natural resources.

The role of people in the landscape helping to manage climate impacts will be crucial and presents a significant opportunity for Indigenous livelihoods. Economic opportunities arising from climate change for Indigenous people living on land may include the need to better manage and restore ecosystems, and the pursuit of carbon mitigation and sequestration activities.

Indigenous people, not connected to government programmes, are actively managing vast tracts of both terrestrial and marine environments using age-old knowledge systems in northern Australia. Limited engagement has occurred in the past between natural resource managers and these traditional owners.

There is a lack of action-based research and analysis relating Indigenous knowledge transmission to expected environmental degradation and other effects due to climatic changes. Research and development should give priority to Indigenous institutions that can act as a means of facilitating the research, whilst maintaining strong direction and input from the community. The benefits of greater Indigenous engagement extend beyond increasing employment opportunities – they can lead to increased connection to country, improve health outcomes and strengthened cultural practice.