

INTEGRATED APPROACH TO REGIONAL CLIMATE CHANGE ADAPTATION STRATEGIES: PROJECT METHODOLOGY, RESULTS AND KEY LESSONS LEARNT

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Abstract

The Sydney Coastal Councils Group Inc (SCCG) and CSIRO working in collaboration with the University of the Sunshine Coast to undertake a project through the Australian Greenhouse Office's National Climate Change Adaptation Program. This integrated assessment project is focused on climate vulnerability in the Sydney coastal region and the adaptive capacity of SCCG Member Councils to address regional climate change adaptation issues. The project explores themes of systems approaches to climate vulnerability, the need for integration, participation of stakeholders, and partnering for science impact.

The project will yield substantial benefits including the understanding of the potential for adaptive management strategies and the barriers and opportunities associated with implementation among Local Governments. In this paper the Project Team presents the project methodologies, and preliminary results and lessons learned from the first two project phases.

Phase one of the project focuses on vulnerability assessment and mapping across five impact areas: heat-related health effects; coastal hazards; urban stormwater management; bushfire and degradation of natural ecosystems and assets. Spatial estimates of vulnerability were determined through the integration of multiple indicators representing the three components of vulnerability: exposure, sensitivity and adaptive capacity. Results indicate the important role of demographic and socioeconomic conditions, and the high degree of spatial diversity associated with climate change vulnerability.

Phase two of the project is comprised of workshops designed to initiate dialogue among researchers and stakeholders within SCCG Member Councils regarding the potential vulnerability of the Councils to climate change. Results of vulnerability mapping were presented to Local Government staff and elected members as a tool to engage Councils in thinking about vulnerability, risk and adaptation. This dialogue aims to develop a more comprehensive perspective on climate change issues within Local Government, and in turn the SCCG region, by exploring the potential adaptive responses and institutional barriers of the councils to adapting to climate change.

Introduction

As part of the Australian Greenhouse Office (AGO) National Climate Change Adaptation Program, the Sydney Coastal Councils Group (SCCG) have partnered with two CSIRO Divisions (Sustainable Ecosystems, and Marine and Atmospheric Research) working in collaboration with the University of the Sunshine Coast, to undertake research on regional approaches to managing climate vulnerability in the Sydney region. The project was scoped following interest in systems approaches to the management of climate variability in the Sydney region by Local Governments, which was documented in a paper presented at the 2005 NSW Coastal Conference (Smith *et al.*, 2005). The project is well underway and scheduled to be completed by October 2008. This paper discusses: (i) the AGO Adaptation Program; (ii) planned research activities; (iii) key concepts and issues to be addressed; (iv) potential benefits to Local Government; and (v) the next steps for the project.

Australian Greenhouse Office National Climate Change Adaptation Program

At the National level, Australia's efforts to assess the implications of climate change and facilitate the implementation of adaptation strategies have largely been initiated through the National Climate Change Adaptation Programme (NCCAP). This four year (2004-2008), \$14.2 million program is an initiative of the Australian Greenhouse Office within the Department of the Environment and Water Resources the three expressed goals of the programme are;

- help Australians understand the likely impacts of climate change
- develop practical tools to support decision making on climate change adaptation
- assist in planning ahead to reduce the risks and capture opportunities.

To date, a range of projects and activities have been executed under the NCCAP including national scoping assessments of climate change vulnerability, which have been followed in some instances by more focused, sector-specific assessment projects. A number of guidance documents have also been generated to build understanding with regards to the costing of climate change impacts and the application of risk management approaches to ameliorate adverse consequences. The Sydney regional integrated assessment project is one of a portfolio of five regional climate change assessment projects recently funded through the NCCAP. The aim of the Australian Greenhouse Office integrated assessment projects are to provide:

- information that decision-makers in the selected settlements can use to make informed adaptation decisions and
- a body of lessons, knowledge, methods and experiences about integrated assessment of climate change impacts that can be applied to a broad range of Australian settlements.

Other study areas include the Clarence City Council, Tasmania; Gold Coast, Queensland; Western Port, Victoria; and a joint Australian Capital Territory and Victoria study. Each of these studies is being developed and carried out independently, with each seeking to address a different suite of issues based upon the interests and concerns of local stakeholders.

SCCG Project Blueprint

The SCCG integrated assessment project has been constructed around a series of phases, with the completion of one phase acting as input into subsequent phases.

- i) **Vulnerability mapping** – Identification of the spatial heterogeneity in vulnerability of the SCCG landscape to various impacts of climate change and the diversity of physical, biological, social and economic drivers that contribute to vulnerability.
- ii) **Stakeholder workshops** – Facilitation of workshops with individual Local Governments to build a dialogue regarding climate change, impacts and vulnerability as well as the capacity within Local Government to adapt.
- iii) **Case studies of adaptive capacity** – Identification of key cross-cutting impacts of climate change along with barriers and opportunities to adaptation among SCCG member Councils and in-depth focus interviews to build further understanding regarding the nature of the barriers.
- iv) **Project assessment** – An ongoing process to evaluate the utility and quality of methods, workshops and their facilitation, project outputs and the suitability of the project approach to application in other parts of Australia.

In the event that the SCCG project or other activities within Local Government leads to the initiation of a specific adaptation response, the Project Team has also proposed follow-up work to establish an evaluation and monitoring framework to assess the effectiveness of such projects and their implementation.

Results to Date

Vulnerability Mapping

To assist in stimulating discussion among Local Government stakeholders within the 15 Member Councils of the SCCG, a vulnerability assessment and mapping exercise was undertaken (see Preston et al., 2007). Vulnerability was framed in a manner presented by the Intergovernmental Panel on Climate Change (IPCC, 2001): *“the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.”* Vulnerability has been previously conceptualised as being comprised of three components: exposure, sensitivity and adaptive capacity (Figure 1; Allen Consulting, 2005). Exposure refers to the presence of a climate hazard. Sensitivity refers to the responsiveness of a system to that hazard. Adaptive capacity refers to the ability of a system to change in a way that makes it better equipped to manage its exposure and/or sensitivity to climatic hazards and/or cope with adverse impacts.

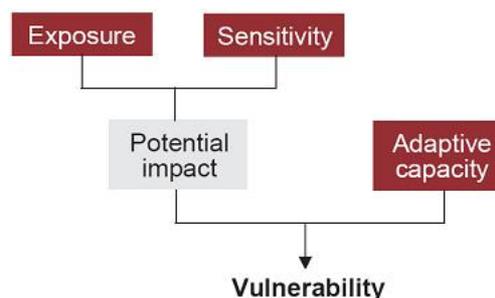


Figure 1. Components of Vulnerability (Allen Consulting, 2005).

For this current project, the above model of vulnerability was operationalised by the identification of data sets representing indicators of exposure, sensitivity and adaptive capacity for five potential climate change impacts: human health effects, coastal hazards, urban stormwater runoff, bushfire and ecosystem degradation (Figure 2). Indicators included current regional climate gradients, projections of future climate change, topography, land use and cover, demographic information as well as indicators of council resources and performance. Furthermore, data for indicators reflected a range of formats, including raster data of varying resolutions and vector (point and polygon) data. To facilitate integration, all data sources were converted to a common spatial reference (90 metre grid utilising the WGS 1994 datum) over the SCCG region.

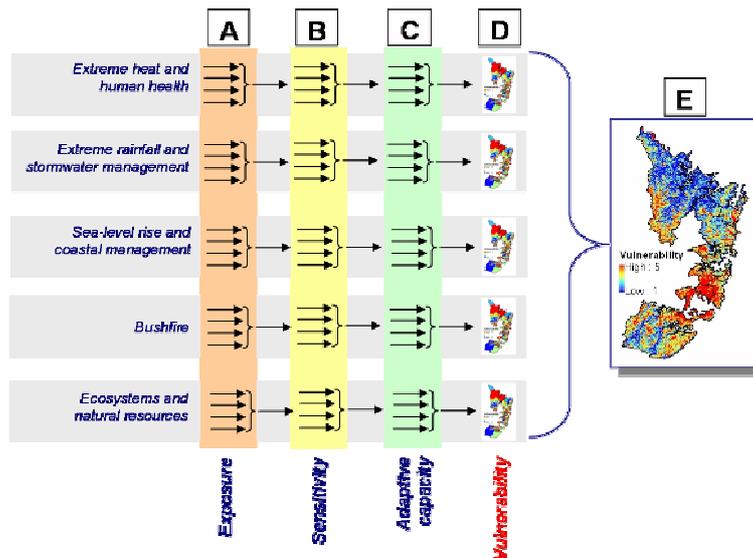


Figure 2. Framework for integration of indicators into exposure (A), sensitivity (B), and adaptive capacity (C) layers. These layers were integrated into a map layer representing net vulnerability for each of the five impacts (D). These vulnerability layers were integrated to generate a map of overall climate change vulnerability throughout the SCCG region (E).

Indicators were subsequently scored qualitatively with a ranking from 1 to 5 (based upon quintiles), with 1 representing a low contribution to vulnerability and 5 representing a high contribution. To prevent differential numbers of indicators for each component from biasing outcomes, indicators for each component of vulnerability (exposure, sensitivity and adaptive capacity; Figure 2) were first summed and rescaled to a range from 1 to 9. In so doing, no assumptions were made regarding the relative importance of individual indicators, in part due to a lack of knowledge regarding their relationships and ultimate implications for risk. The three components were subsequently summed and rescaled to estimate net vulnerability for each impact. Individual components were assigned differential weights based upon expert judgment regarding their relative significant for vulnerability. The advantage of this approach was that it readily allowed a broad array of potential risk factors to be explored and different indicators could be added or deleted at will (Turner et al., 2006). This is conducive to diagnosing the various factors and interactions that contribute to vulnerability and climate risk as a means of generating thought regarding processes that affect risk and its management within Local Government.

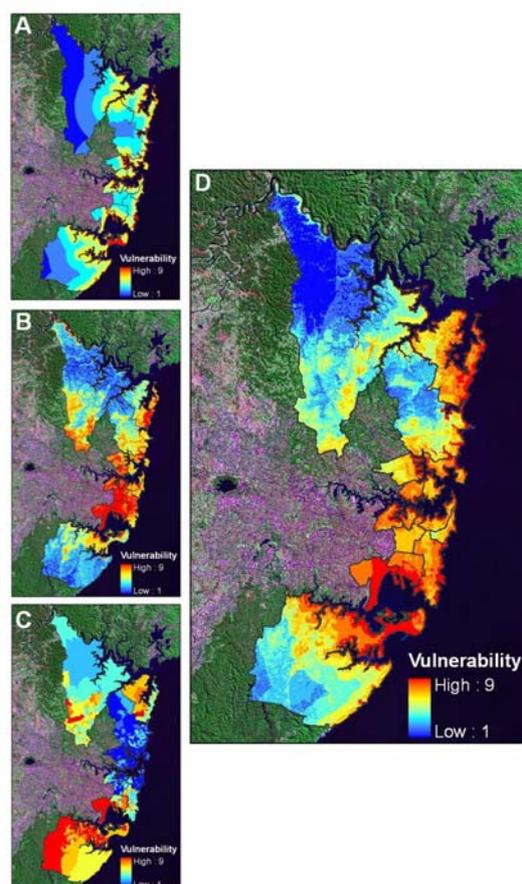


Figure 3. Vulnerability of the SCCG coastline to climate change, sea-level rise and storm surge events. Figures A, B, and C represent the three components of vulnerability: exposure, sensitivity, and adaptive capacity, respectively. Each of these components is determined independently of the others. D represents the integration of these components into net vulnerability. High values indicate a relatively high degree of coastal vulnerability while low values indicate a low degree of vulnerability.

As illustrated by the vulnerability map for sea-level rise and coastal management (Figure 3), vulnerability varies significantly across the SCCG landscape. In this instance, vulnerability was concentrated in the coastal zone, particularly in low-lying areas around Botany Bay and Pittwater Bay. Secondary vulnerability was observed in estuaries and upstream regions, whereas higher elevation areas and those inland are naturally associated with lower vulnerability. Nevertheless, land areas and infrastructure several kilometres inland are not necessarily immune to coastal hazards (e.g., winds associated with storms events).

Similar maps were generated for the other four impacts, and results were averaged over each of the 15 SCCG Councils to generate aggregate vulnerability scores for Local Government. The presentation of the vulnerability assessment and mapping to Local Government stakeholders through a series of 15 workshops enabled stakeholders to jointly consider the nature of that vulnerability as part of a social learning process (Keen et al., 2005). The contribution of individual components and even individual indicators to spatial patterns of vulnerability enabled investigators and stakeholders to understand the diversity of risk-factors for climate impacts and some of the key linkages. Ultimately, this exercise was designed to encourage stakeholders to think about the local environment as a complex system comprised of multiple drivers, responses and interactions. Feedback from stakeholders regarding the utility and appropriateness of different vulnerability maps was incorporated into subsequent revisions and updates of the vulnerability assessment.

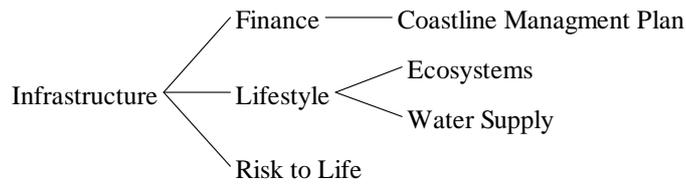
Stakeholder Workshops

By 1 November of this year, a total of 15 workshops will have been conducted, one in each SCCG Member Council. Each workshop was comprised of 10 to 25 Council staff members from a range of departments within Council, often including senior department representatives. Over the course of the workshops, participants were facilitated through three primary activities.

First, participants were provided with an overview presentation of the vulnerability mapping exercise which included general information regarding regional climate projections and impacts as well as specific results of the mapping. Participants were encouraged to question the results and assumptions and make suggestions regarding additional sources of data, points of conflict with local knowledge, and suggests for other potential applications of the work.

Second, workshop participants contributed to a mental mapping exercise. Participants identified a series of key impacts of climate change that were relevant to individual councils, the climate and non-climate drivers influencing those impacts and a number key management activities undertaken by Local Government to address those impacts. These various elements were mapped out and connections between drivers, impacts and management options were identified by the participants. The resulting mental map was entered into a software package known as Vensim® (Figure 4a), which enabled stakeholders to explore the direct and indirect drivers for impacts of concern (Figure 4b), linkages between these impacts, and the downstream direct and indirect consequences of management interventions (Figure 4c). Facilitators discussed the potential implications of this analysis, such as the identification of where interventions may achieve the most far reaching effects as well as potential areas where management interventions may have indirect consequences or benefits not commonly recognised in decision-making.

Third, participants were asked to nominate between one and four (depending upon the number of participants) impacts or associated issues from the mental mapping that appeared to be particularly relevant or important for further discussion. Participants were subsequently divided into smaller discussion groups of 3 to 6 individuals and charged to rate the perceived vulnerability and management capacity of Council with respect to the nominated issue. In addition, participants were asked to brainstorm about the potential limits or barriers that exist for Council staff or the larger community with respect to addressing nominated issues. Participants were also asked to identify opportunities that may exist due to internal Council capacity skills or culture as well as external factors.



Impact → Direct Consequences → Indirect Consequences

Figure 4c. The figure above illustrates that there may be a multiple downstream direct and indirect consequences of an impact of concern.

Given the number of Councils within the SCCG and the diversity associated with their respective priorities and concerns regarding climate change, a broad range of both barriers to and opportunities for adaptation were identified by workshop participants. These various barriers and opportunities can be crudely categorised into four groups (Figure 5) that collectively shape the adaptive capacity of Local Governments. Undoubtedly this is an over-simplification of the wealth of information acquired from workshop participants and the complexity of the issues discussed, particularly given the number of interactions that can readily be described. Nevertheless, this framework is useful for summarising results in the context of this paper. Each of these four categories is discussed further below:

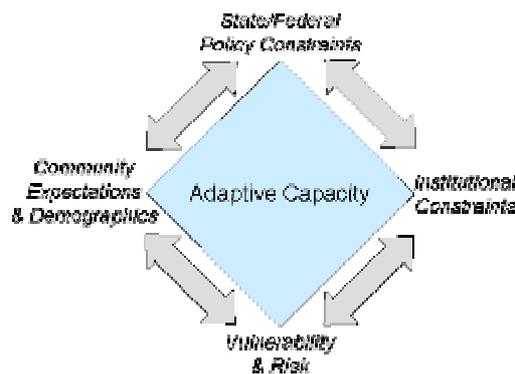


Figure 5. Four core categories of issues affecting the adaptive capacity of Local Governments in the SCCG region.

Vulnerability & Risk

Councils frequently identified key climate-related hazards to which they were chronically exposed, even if such exposures were limited to isolated areas. For example, certain beaches were seen as being critical management challenges due to persistent problems with erosion or the low-lying nature of the topography. Similarly, for some of the regional Councils, bushfire risk was seen to be an inherent property of the landscape. Hence, there were seen to be some fundamental limits to the capacity of Local Government to adapt to the effects of climate change in high risk locations. This is not to say that response efforts could not be ramped up to address future enhancements of risk. Rather that a minimal level of residual risk is likely to be present regardless of management efforts.

State/Federal Policy Constraints

Almost all of the Councils acknowledged the constraints imposed on Local Government by State and Federal policies (or the lack thereof) as a significant barrier to adaptive management of climate change and its risks. Councils stated that reforms of local planning schemes to account for changes in climate change (e.g., allocation for future sea-level rise in coastal setbacks) had to be led or at least sanctioned from the top-down. This is in order to ensure a consistent framework and level playing field across Local Governments, to secure funding for certain projects (e.g., transportation) and to insulate Local Government from litigation arising from opposition to such policy changes.

Institutional Constraints

Some of the barriers to adaptation also arise from within Local Governments themselves. These include fundamental constraints on available funding for risk assessment, staff, and the implementation of infrastructure projects. Barriers also arise from the policy atmosphere, whereby adaptive responses may not be priority policy issues for Council or may not be seen as politically expedient. Generally, Councils are focused on policy and management over the relatively near-term, and thus are unaccustomed to managing climate risk which is commonly perceived as being relevant over time scales of decades to centuries. Instead, though not a ubiquitous occurrence, Councils tended to view climate change through the lens of current policy or management challenges within Council and/or through the much broader contextual lens of sustainability. This suggests that Councils do not view addressing climate change as a simple linear exercise of risk management, whereby enhanced climate risks are targeted by direct intervention. Rather, Council staff appear to maintain a relatively complex view of the community, the pressures on the community, and the decision-making environment. As such, there may be some fundamental capacity building required before communities can move forward with more targeted interventions for climate change such shifts in attitudes within the community, updating of infrastructure, and reforms to ensure more widespread availability of mass transit.

Community Expectations and Demographics

Local Government is charged with being responsive to the interests and priorities of the community. This creates the potential for challenges in climate change adaptation, where policies protective of community-wide assets and resources over the long-term may be perceived to be in conflict with short-term protection of individual rights and assets. In addition, community members may seek the minimisation of rate collection and Council spending on one hand, yet demand rapid responses from Councils in the event of emergency. More generally, the demographics and wealth differences of Local Government areas affect the resourcing of Local Government sustainability and climate change adaptation programs and awareness within council of climate change issues. Community awareness of climate change impacts is therefore important in providing support for Local Government efforts. Also, one cannot overlook the importance that a healthy culture within Local Government with respect to staff relationships and trust can play in adaptation.

Discussion and Conclusions

It is increasingly clear that Local Governments play a critical role in managing the adverse consequences of climate change. This arises from the fact that while climate change is a global problem, its impacts often manifest at the local level. Furthermore, in Australia, Local Government is charged with a range of planning and risk management activities that are central to preventing or mitigating climate consequences. Ultimately, increasing the capacity for Councils to incorporate or 'mainstream' the consideration for future changes in the climate system into their existing portfolio of management responses would represent a significant step forward in local to national preparedness.

Achieving such an outcome is a non-trivial task. First and foremost, it requires Council to have both a built-in knowledge regarding future climate change and its implications as well as reliable access to additional expertise, data and information on the subject. The SCCG project represents an opportunity to increase the flow of information regarding climate change and its consequences into Local Government including the identification of institutions and individuals that can assist in data and information provision. What is perhaps more difficult is to recognise the broad range of pathways by which climate change may directly and indirectly influence assets and processes of importance within the scope of Local Government operations. The mental mapping exercise conducted through the SCCG Council workshop process provides a brief introduction into building this type of vision within Local Government. The workshops also provided an opportunity for staff from various sectors within Council to communicate with one another on climate change, a potentially valuable social learning opportunity. Nevertheless, the SCCG project generally reveals significant progress must be made in increasing the level of awareness and knowledge regarding climate change within Local Governments if they are to contribute to adaptation efforts.

Clearly, however, there are numerous barriers to Local Government adaptation that originate outside of Councils. In particular, the dual demand upon Councils to be both responsive to the community while operating within the constraints imposed from higher levels of government is a core challenge. Conflicts between community and Councils' preferences for management strategies may be difficult to resolve and force Local Government into a response-oriented operational framework that limits proactive management, particularly over the long-term. Meanwhile, the requirement that various planning tools be sanctioned within State Government policies prior to their implementation at the local level indicates that climate change adaptation must be harmonised across all levels of government and with the community if it is to move forward. This suggests that institutional relationships and conflicts may be a critical limiting step in climate adaptation.

On a more positive note, however, the SCCG project is helping to make such barriers more transparent and, hopefully, more amenable to being addressed in a coordinated manner. It is anticipated that regional SCCG priorities and circumstances notwithstanding, the documentation of adaptation challenges as observed within the SCCG will have relevance within Local Governments across Australia. It is also hoped that the methods utilised for vulnerability assessment and stakeholder interaction within the project will expand the toolkit of approaches that exist for engaging the public and different institutions on climate change and adaptation.

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