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Climate Change Adaptation and Multilevel Governance in the Great Barrier Reef

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This paper examines how Australian governments are adapting to climate change in the context of the Great Barrier Reef (GBR). It documents numerous examples of adaptation strategies that apply to the GBR region. Adaptation strategies are examined in terms of types, purposefulness and triggers. The concept of institutional interplay (i.e., interactions between and among institutions) is explored to highlight the importance of considering linkages between strategies to improve adaptation. This study shows that adaptation in the GBR region is happening at all levels of government, from local to national; however, it has been primarily driven by the federal and state governments. Adaptation in the region is characterised by a wide range of strategies (e.g., policies, plans, programs, research and information, tools and guidelines, and legislation). Interactions between and among these strategies are pervasive, because many of the strategies are functionally interdependent. A more strategic framework that clearly defines objectives, responsibilities, costs, and strategies for adaptation across governments is needed, if interplay is to be purposefully used to improve climate change adaptation.

Keywords: adaptation, climate change, interplay, multilevel governance, Great Barrier Reef, Australia

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1. Introduction

The rise in temperatures in Australia has over the last decade resulted in decrease in rainfall in parts of Western Australia, Victoria and South Australia; more severe droughts; decline in spring snow cover in alpine regions; and serious bleaching events in the Great Barrier Reef (Australian Government, 2010). It is very likely that we will continue to feel these and other climate-related impacts well into the future even if significant reductions in global greenhouse emissions are achieved today.

Adapting to unavoidable impacts from climate change has been one of main approaches comprising Australia's response to the Earth changing climate system (DCCEE, 2010c). Australia has been considering climate change adaptation for the last five years or so across all tiers of government. A major National Climate Change Adaptation Program was launched by the federal government in 2004. The Council of Australian Governments (COAG) released a National Climate Change Adaptation Framework in 2007. At the state government level, the Queensland government adopted the *ClimateSmart* Adaptation Plan, also in 2007. Adaptation is also happening at the local government level. Individual councils and state and national local government associations have been developing initiatives on climate change impacts and adaptation (e.g., LGAQ, 2007).

Whereas the process of adaptation is not novel; the idea of incorporating future climate risk into policy-making is both new and challenging (Tompkins et al., 2010). Therefore, understanding institutional responses to climate change (e.g., policies, legislation, decision-making processes etc.), and what lessons can be learned from different institutional arrangements comprise top research priorities (NCCARF, 2010b). Furthermore, research has to date mostly focused on national and international responses. Adaptation processes, however, operate at different spatial, temporal, social, and administrative scales. Hence, to truly understand what contributes to effective adaptation, multiple levels need to be investigated. This includes examining the interactions between and among institutions at, and across these levels, also known as institutional interplay.

This paper investigates how Australian governments are adapting to climate change by using the Great Barrier Reef (GBR) as a case study. It documents numerous examples of adaptation

strategies that apply to the GBR (e.g., policies, plans and programs). Adaptation strategies are examined in terms of types, purposefulness and triggers. The concept of institutional interplay is explored to highlight the importance of deliberately considering linkages between strategies to improve adaptation policy.

The rest of this section introduces the concept of institutional interplay and the case study context. Section 2 describes the methods used in this study and Section 3 presents the findings. Section 4 covers the discussion and concluding remarks.

1.1. Interplay

Interplay refers to the interactions between and among institutions. It may occur both vertically and horizontally. Horizontal interactions occur at the same level of social organisation (e.g., at the local, state or federal levels); whereas vertical interplay concerns the interactions linking strategies located at different levels (e.g., between state and federal levels). Interplay can be considered as functional interactions, when substantive problems addressed by two or more institutions are linked in biogeophysical or socioeconomic terms. In this case, the operation of one institution directly influences the effectiveness of another. Interplay also features political linkages, or politics of institutional design and management, when actors create links between institutions in order to advance individual or collective goals (Young, 2002). The notion of institutional interplay is key to understanding how linkages between strategies could be used to improve adaptation, and to identify gaps that need to be addressed to facilitate adaptation.

1.2. The Great Barrier Reef

The GBR is the largest coral reef ecosystem in the world. It spans 2,300 km along two thirds of the east coast of the state of Queensland, extending 70 to 250 km from the coast (Figure 1). The GBR comprises a site of outstanding ecological significance and of great social, economic and cultural value for the people of Australia (GBRMPA, 2009b).

Climate change is the most important long-term threat for the GBR (GBRMPA, 2009b). Indeed, climate-related events have already caused significant impacts. Increases in sea temperatures, for instance, have caused extensive coral bleaching (Hoegh-Guldberg, 2007;

Hoegh-Guldberg et al., 2007; Thompson and Dolman, 2010). Sea-level rise, ocean acidification and increased weather variability and intensity (e.g., rainfall, droughts, river flow and tropical cyclones) are anticipated to further adversely affect the Reef system (Hoegh-Guldberg, 2007). In addition, climate change effects are predicted to interact with other stressors, such as poor water quality resulting in detrimental synergies (Wooldridge, 2009). The effects of climate change will ultimately undermine the ability of the GBR to deliver ecosystem goods and services, which regional communities and industries rely on (Johnson and Marshall, 2007). In this context, adaptation to climate change emerges as a key issue requiring immediate action. Given the multiple jurisdictions involved in the governance of the GBR, climate change responses will involve actions, sometimes in a collaborative fashion, by federal, state and local governments.

Figure 1: GBR region (GBRMPA, 2009b)

2. Methods

This study included a survey of a range of adaptation documents, conducted during 2010. The inventory of adaptation strategies comprised reports, plans, legislation, policies, submissions, studies and assessments, fact sheets, newsletters and media releases. Key sources of information comprised the websites of government agencies and departments, which have a role in climate change adaptation. These agencies and departments included the Department of Climate Change and Energy Efficiency[1], Queensland Office of Climate Change[2], Great Barrier Reef Marine Park Authority[3], Department of Sustainability, Environment, Water, Population and Communities[4], Queensland Department of Environment and Resource Management[5] and local governments (e.g., Cairns Regional Council[6]). In addition, internet search was performed using a combination of terms (e.g., "adaptation", "climate change", "Great Barrier Reef", "resilience", "water quality", "coastal development") to capture the grey literature.

Three criteria were used to ensure consistency when determining the inclusion or exclusion of documents in the compilation of adaptation strategies. First, the area of the GBR and its adjacent coastal catchments framed the geographic scope of the study. Second, documents should address activities and processes in response to actual or perceived impact of climate change (e.g., coral bleaching, coastal erosion). Lastly, response to climate change in the GBR region should involve strategies by federal, state or local governments or regional Natural Resources Management (NRM) bodies, which increasingly have a role in coordination of NRM in Australia and the GBR catchment (Peterson et al., 2010). The strategies identified were analysed using the software NVivo 8 (QSR International).

[1] http://www.climatechange.gov.au
[2] http://www.climatechange.qld.gov.au
[3] http://www.gbrmpa.gov.au
[4] http://www.environment.gov.au
[5] http://www.derm.qld.gov.au
[6] http://www.cairns.qld.gov.au/

3. Findings

A number of strategies pertaining to the public sector at multiple levels of government apply to adaptation in the GBR. These strategies include production of new, or integration and synthesis of existing information; policies, plans and programs; planning and natural resource management legislation; tools and guidelines to cope with climate impacts; and establishment of committees and networks (Table 1).

Table 1: Main types of adaptation in the Great Barrier Reef region

Adaptation	Example
Information & Research	- The *Great Barrier Reef Outlook Report 2009* identifies climate change as a major threat to the Reef, and highlights gaps in information required for an improved understanding of the ecosystem resilience. - *Climate Change and the Great Barrier Reef: A Vulnerability Assessment* examines the vulnerability of GBR species, habitats and key processes to climate change.
Policy, Plans, Programs	- *Great Barrier Reef Climate Change Action Plan* outlines actions to increase the resilience of the GBR. - The *National Climate Change Adaptation Framework* presents a strategy for coordinating the actions of Australian governments.
Legislation	- *Marine Parks Act 2004* (Queensland) includes consideration of issues related to the resilience of the reef system (e.g., protection, conservation, restoration of the environment) - The *Sustainable Planning Act 2009* (Queensland) requires consideration of climate change as a matter of environmental protection and ecological sustainability
Tools & guidelines	- *Adapting to Climate Change a Queensland Local Government Guide* helps local councils assess the risk of, and respond to climate change. - *Adaptation to Climate Change in Regional Natural Resource Management Plans* provides guidelines to address climate change in developing NRM plans.
Committees & networks	- The GBR Tourism Climate Change Action Group consists of representatives from GBRMPA, Queensland Department of Environment and Resources Management, and the tourism industry, and addresses climate change issues for this industry. - NCCARF Adaptation Research Networks facilitates collaborative climate change adaptation research, exchange of information and resources sharing.

The most prominent adaptation strategies have been adopted at the federal and state levels. At the federal level, the National Climate Change Adaptation Program involves investments of A$126 million to help manage the risks and capture the opportunities associated with climate change (DCCEE, 2010a); the National Climate Change Adaptation Framework outlines an agenda for collaboration, particularly between federal and state governments (COAG, 2007); and the establishment of the National Climate Change Research Facility comprises a multidisciplinary effort to generate the necessary information so that decision-makers,

industries and communities are better prepared to manage the risks of climate change (NCCARF, 2010a). At the state level, the Queensland *ClimateSmart* Adaptation Plan, a five year plan, comprises a wide range of actions aimed to improve the understanding about the impacts of climate change and build capacity to manage those impacts (Office of Climate Change, 2010).

Some adaptation strategies were purposefully designed as primary responses to climate-related impacts. The GBR Climate Change Action Plan, for instance, outlines measures to maximise the resilience of the Reef in recognition of the threats posed by climate change (GBRMPA, 2007). Other strategies were developed to address non-climate issues, such as the Reef Water Quality Protection Plan for Catchments Adjacent to the GBR (the Reef Plan), but are believed to provide adaptation benefits to the Reef (Table 2).

Table 2: Examples of adaptation responses in terms of purposefulness

Climate	**Non-climate**
- Coral Bleaching Response Plan - GBR Climate Change Action Plan - *ClimateSmart* Adaptation - Local Adaptation Pathways Program - Implications of Climate Change for Australia's World Heritage Properties: A Preliminary Assessment - Australia's Biodiversity and Climate Change: A Strategic Assessment of the Vulnerability of Australia's Biodiversity to Climate Change	- Caring for our Country Programme - *GBR Outlook Report 2009* - *Coastal Protection and Management Act 1995* - GBR Marine Park Zoning Plan - Q2 Coasts and Country Program - *Sustainable Planning Act 2009*, Queensland - Reef Plan - Reef Rescue - NRM Plans

Various drivers have led to the development of adaptation strategies (Table 3). Actual or perceived climate-related impacts on the GBR are the most apparent trigger of adaptation. For instance, the Coral Bleaching Response Plan was developed because of a major bleaching event that occurred in 2002 (GBRMPA, 2009a).

Adaptation is also specifically supported by the management of the GBR Marine Park, which includes both policy and management strategies with a particular focus on increasing ecosystem resilience (Marshall and Johnson, 2007). For instance, the *Great Barrier Reef Marine Park Zoning Plan 2003* seeks to protect key functional groups, protect refugia, conserve biodiversity and implement ecosystem-based fisheries management. GBRMPA's Reef Guardian Council program, which fosters environmental stewardship for the GBR from local government and the general community (GBRMPA, 2010) is another example.

Table 3: Drivers of adaptation

Trigger	Example
Impacts of climate change	- Experienced or perceived climate induced impacts such as coral bleaching
GBR Marine Park Management	- Strategies developed for the management of the GBR Marine Park
Legislation	- Statutory requirements and sustainable development principles
Natural Resource Management	- NRM issues, such as water quality, biodiversity and erosion and soil conservation
Planning & management schemes	- Coastal management and protection, state planning schemes

Legislation and policy have also fostered adaptation in the GRB region. For instance, the *Great Barrier Reef Marine Park Act 1975* was amended in 2007 requiring the preparation of an outlook report every five years. The *Great Barrier Reef Outlook Report 2009* identifies climate change as a major threat to the GBR, and highlights gaps in information required for an improved understanding of the ecosystem resilience (GBRMPA, 2009b).

Strategies concerning NRM also aim to facilitate adaptation. Decreased water quality from adjacent catchments and its impact on the GBR has motivated actions such as the Reef Plan – a joint initiative from state and federal governments – and the federal government's Reef Rescue Program. By reducing the stress from water quality to the Reef, these initiatives support increased resilience of the system to other impacts, including climate change (Johnson and Marshall, 2007). In addition, regional NRM plans and projects address relevant issues to adaptation in the GBR region, such as water quality and biodiversity conservation.

Climate change considerations have also been incorporated into planning and management schemes. These schemes include the Shoreline Erosion Planning Scheme and state and regional Coastal Management Plans. For example, the Wet Tropical Coast, Cardwell-Hinchinbrook and Curtis Coast Regional Coastal Management Plans take into account climate change impacts, such as sea-level rise.

Adaptation in the GBR region features horizontal and vertical interplay (Figure 2). Horizontal interplay includes, for example, the National Climate Change Adaptation Framework and National Climate Change Adaptation Program supporting the development of the vulnerability assessment for the GBR; and incorporating climate change consideration into Queensland planning policies, such as the State Coastal Management Plan, as part of the

AdaptationSmart Plan. Vertical interplay includes the Local Adaptation Pathways Program, a component of the National Climate Change Adaptation Program, which provided around $2 million in funding to assist local governments assess risks to climate change and develop action plans. In the GBR region, projects from Townsville City Council and Cairns Regional Council benefited from the Local Pathways Program (DCCEE, 2010b). At the state level, the *ClimateSmart* Plan providing support to the *Adapting to Climate Change a Queensland Local Government Guide* developed by the Local Government Association of Queensland is another example of vertical interplay. Further vertical interplay comes through the guidance to local councils provided by the regional planning process. For instance, the Far North Queensland Regional Plan 2025 is a non-statutory instrument, which existing institutional arrangements, such as local government planning schemes (e.g., Cairns Regional Council's Climate Change Action Plan) and NRM plans need to take into consideration.

Functional interplay accounts for most of the interactions between adaptation strategies. Many strategies focus on separate but interconnected issues (e.g., water quality, coastal management, GBR resilience), which are supportive of adaptation. For example, the *Great Barrier Reef Marine Park Zoning Plan 2003* helps improve the resilience of the system to both non-climate and climate stressors by defining zones of uses (e.g., fishing, conservation, tourism and recreation) based on a Representative Area Program of bioregions.

Political linkages explain, to a lesser extent, interactions between adaptation strategies. An example is creating links between regional NRM plans and the Reef Rescue program and the Reef Plan. In this case, the NRM plans are required to prioritise actions that support the Reef Rescue program and the Reef Plan if they are to be accredited and funded under the joint state and federal government NRM scheme. The accreditation process creates incentives for the NRM plans to take into account and help implement related natural resource management efforts.

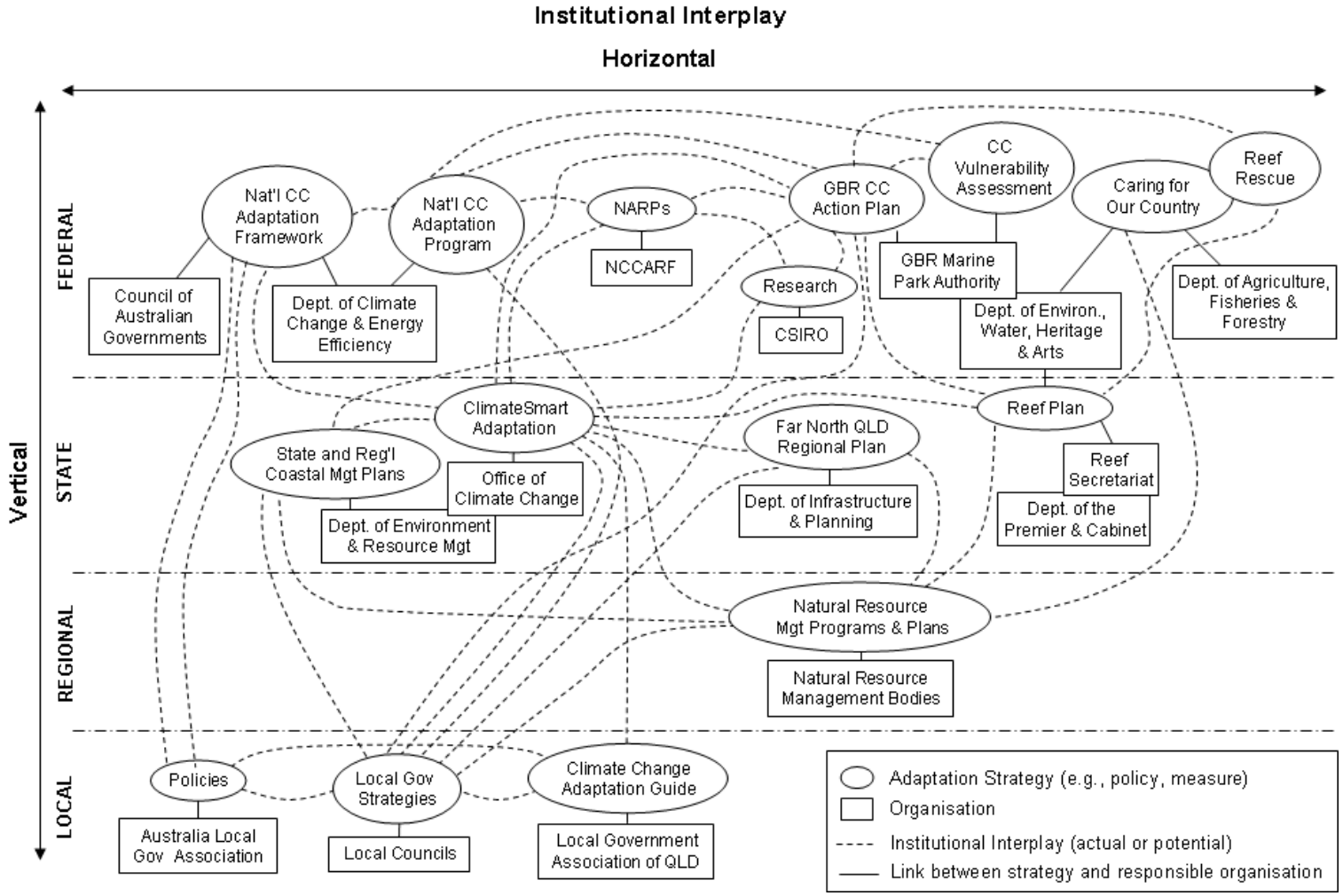

Figure 2: Examples of interplay between and among climate change adaptation strategies for the Great Barrier Reef region.

4. Discussion

This study shows that adaptation is happening at all levels of government, from local to national and is characterised by a wide range of strategies. These strategies have in general focused on building adaptive capacity, as opposed to implementing adaptation (Tompkins et al., 2010). Building adaptive capacity is regarded as a key role for governments in responding to climate change (see Australian Government, 2010). Such role is reflected, for example, in the research, assessments and a number of plans supported by federal and state governments. It is expected that adaptive capacity is translated into action as adaptation strategies are implemented (Tompkins et al., 2010).

Adaptation to climate change has been primarily driven by the federal and state governments. At the local government level, adaptation has been inconsistent and constrained by a number of factors including insufficient resourcing, uncertainty and short-term time horizons (Leitch and Robinson, 2009). An important limiting factor is a general lack of financial support from federal and state governments to build capacity of local governments (LGAQ, 2008). For example, assistance from the National Local Adaptation Pathways program has benefited to date only two local councils (i.e., Cairns Regional Council and Townsville City Council) (DCCEE, 2010b) out of some forty councils within the GBR region. Both the Australian Local Government Association and Local Government Association of Queensland have expressed concern about the inadequate level of resources provided by state and federal governments to help local councils develop adaptation strategies (LGAQ, 2008; NGA, 2009). Financial and technical support from federal and state governments is critical to facilitate meaningful adaptation at the local level.

This study also demonstrates that interactions between and among strategies are pervasive. Because the GBR comprises a coupled social-ecological system (Folke, 2007), strategies addressing separate but cross-cutting issues (e.g., water quality, resilience, biodiversity and coastal development) and dimensions (e.g., ecological, socio-economic and institutional) of climate change are functionally interdependent. Institutional interplay is a fact of life in complex societies. The resulting interactions largely influence institutional performance and robustness in face of stresses (Young, 2002). Therefore, it is important to manage interactions to ensure that positive effects of strategies on one another are reciprocal (Young, 2002), or at

least that they do not offset or conflict with each other resulting in maladaptation (Barnett and O'Neill, 2009). The challenge is to purposefully take advantage of interplay to improve climate change adaptation at multiple levels. In this regard, a more strategic framework that clearly defines objectives, responsibilities, costs, and strategies for adaptation across governments is needed. Arrangements at federal and state government levels need to provide a supportive context for regional and local strategies, so that critical and effective adaptation can emerge.

This study has focused on documentation and archival records. Further work involving interviews with GBR-relevant decision-makers is planned. Such work will provide a better understanding of the reality and complexity, in which adaptation is implemented and what opportunities and constraints exist for interplay management.

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