

Adaptive governance: An introduction, and implications for public policy

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Abstract

Adaptive governance is a concept from institutional theory that deals with the evolution of institutions for the management of shared assets, particularly common pool resources and other forms of natural capital. This paper is the first of a set of four papers on adaptive governance, providing a brief overview of the history of the concept, the distinguishing features of the literature, and key insights provided for economists and policy advisors. We argue that adaptive governance provides an interesting lens for examining the political economy of policy responses – akin to the concept of market failure within economics, but applied to wider processes of social learning and collective choice, including collective choices about the scope and structure of institutions that govern lower level choices by individuals and organizations.

Key words: adaptive governance; public policy; common pool resources; natural resource management; wicked problems

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Introduction

The papers that make up this special edition argue that the emerging concept of adaptive governance provides interesting and valuable insights for economists involved in the analysis and development of public policy, particularly in the areas of natural resource management and environmental policy.

Adaptive governance is a concept from institutional theory that focuses on the evolution of formal and informal institutions for the management and use of shared assets, such as common pool natural resources and environmental assets that provide ecosystem services. As such, the notion encompasses both the ‘efficiency’ and ‘adoptability’ of potential institutional arrangements, contributing to a clearer understanding of options for addressing different types of market and institutional failures which may impede the development and implementation of welfare-enhancing policy options (see Bowles 2003, Ostrom 2005).

We consider adaptive governance has a role akin to the concept of market failure within economics, but applied to wider processes of social learning and collective choice, including collective choices about the scope and structure of institutions that govern lower level choices by individuals and organizations. This can add value to the contributions of resource economists and policy advisors by articulating a theory of collective action and political decision making that (i) helps identify and address the key factors that influence the adoption or non-adoption of welfare enhancing policy recommendations; (ii) is itself consistent with the key tenets of economic theory; and (iii) provides a bridge between economics and a variety of related disciplines (such as experimental economics and evolutionary game theory).

This article provides a brief introduction to notion of adaptive governance. Section One outlines the historical roots of adaptive governance, while Section Two defines a number of key terms and concepts. Sections Three and Four outline a number of distinguishing features of the adaptive governance literature, and its approach to governing common pool resources. Section Five illustrates the potential to apply these some of these insights more broadly – such as to the

development of policy addressing ‘environmental bads’. The article concludes in Section Six with a brief summary of key points and an indication of how these issues are explored further in the other papers of this special edition.

Section One: The genesis of adaptive governance

The notion of adaptive governance has emerged from the intersection of two areas of inquiry: the application of ecological systems theory to natural resource management, catalyzed by the work of Buzz Holling and continued by the Resilience Alliance (see Gunderson and Holling 2002), and the study of self governing institutions led by Elinor Ostrom. Both of these literatures are explicitly integrative, and the adaptive governance literature draws widely on ideas from political economy, resource and environmental economics, experimental economics, evolutionary game theory, organizational theory, ecology, systems theory, and complex systems science.

The notion of adaptive management was introduced by Holling (1978) and collaborators as a critique of science based ‘centralized expert management’ practices that gave too little attention to the complexity and uncertainty of ecosystem processes. Their alternative was to conceive of natural resource management as a series of experiments intended to improve both the resource management outcomes (such as the supply of fish or timber or fresh water), and the managers’ understanding of the resource and its supporting ecosystems (see Lee 1999). This approach led, over time, to a more general theory of system dynamics and regime phases in ecological systems and interdependent social-ecological systems (Holling and Meffe 1996, Gunderson and Holling 2002, Folke et al 2004, Olsson et al 2004, Walker et al 2006a).

This systems thinking intersected with Ostrom’s work on the social dynamics of natural resource management, which was grounded primarily in the study of traditional institutional arrangements for intensively managed irrigation and forest resources. This work on self governing institutions explicitly challenges the presumption that the tragedy of the commons is best resolved through externally imposed expert management, citing numerous examples of locally evolved autonomous institutional arrangements that have sustained common pool resources for centuries, and identifying general principles or conditions that enable adaptive governance and management (Ostrom et al 1992, Ostrom et al 1999, Dietz et al 2003).

Early contributions to these convergent literatures focused on making the case for adaptive management (Holling 1978), or the case against centralised expert management (Ludwig 1993, Levin 1993, Holling and Meffe 1996). Later contributions emphasised case studies exploring the implementation and progressive development of adaptive management arrangements for specific geographic areas or natural resources (see Hennessey 1994, Antypas and Avramoski 2004). These local case studies have found both that the practice of adaptive management has not been as clean or ‘scientific’ as was envisaged at the outset, but also that the messiness and unplanned incrementalism of real world resource management has some advantages over the original ideal (see Brunner et al 2005). Other authors have identified practical difficulties in implementing the adaptive management ideal (see Allan and Curtis 2005). Sutherland (2006:599), for example, observes that the notion of “testing hypotheses is excellent in principle and widely advocated. In reality, however, it is almost never carried out because the changes in management usually have to be severe in order to bring about detectable changes in a reasonable time, and the political risks of such management are usually considered too high”

These reflections have prompted theories on the evolution of governance arrangements more generally, and governance principles for promoting sustainable development (Brunckhorst 2002, Dietz et al 2003, Olson et al 2004, Kemp et al 2005). The resulting literature on adaptive governance is growing rapidly, albeit from a low base. A literature search on ‘adaptive’ and ‘governance’ yielded 60 references in this field, half of which occurred in 2003 to 2006.¹ Only nine results were found searching for ‘adaptive governance’ as a phrase, all of which were published in the last three years, including two books published in 2005 (Brunner et al 2005, Scholz and Stiftel 2005). This may be contrasted with a search for the phrase ‘adaptive management’, which yielded 789 references beginning in 1980, including 535 in environment related journals. The earliest two adaptive governance references were from 1993 and 1994, and described the evolution of adaptive management practices in estuarine ecosystems (Imperial,

Hennessey and Robadue 1993, and Hennessey 1994). The most cited articles are Kay et al (1999) 'An ecosystem approach for sustainability: Addressing the challenge of complexity', with 49 citations, and Ostrom's (1999) presidential address to the American Political Science Society with 46 citations.

Section Two: Key terms

One of the challenges of multidisciplinary collaboration is that different disciplines frequently use similar terms to mean different things, giving rise to considerable confusion. To avoid this problem, this section outlines some of the key terms that underpin the adaptive governance literature, particularly the concepts that define the focus and boundaries of this concept.

Governance

Governance refers to the institutional arrangements which shape actors' decisions and behaviour, including the exercise of authority within groups or organizations (such as firms or nations).

Institutions are interpreted as including rules and norms (Ostrom 2005). Rules refer to formal enforceable principles, such as laws established by statute or common law precedent and backed by various forms of legal sanction. In some cases analysis will distinguish between 'rules in operation' (that impact on behavior) and 'rules in law' (which are not necessarily complied with or enforced). Norms refer to shared attitudes, values, and cultural traditions which are maintained and transmitted by a wide variety of positive and negative rewards (such as esteem, access to resources, social support, and risk sharing arrangements). The notion of institutions is also interpreted to include, but does not usually emphasize, organizations and government agencies (such as the High Court of Australia, the *New York Times*, World Trade Organization, and the Anindilyakwa Land Council).

This implies that governance operates at multiple levels and relies on different underlying sources of authority (Burriss et al 2005, Lebel et al 2006). The behavior of firms, for example, is governed by federal and state laws, and by the expectations of shareholders. The behavior of individuals within a firm is governed by company culture and norms, formal company policy (including reward systems), external laws, and wider social attitudes. These various influences are often in tension. Governance is thus essentially fluid, mediating the formal and informal negotiation of decisions between actors with different forms and degrees of influence (such as conferred by their office, resources, information, public standing and other factors, see Kemp et al 2005). Governance is also not synonymous with 'government' or public policy, with the literature drawing attention to a variety of non-state governance options, which – where feasible – may often be more flexible and involve lower transaction costs than the imposition of new government regulatory arrangements (see Cashore et al 2004, Marshall 2005).

Management

Management – by contrast to governance – refers to the processes of decision making, coordination and resource deployment that occur within a given institutional setting, assuming no change in rules and norms.

Management is closely associated with leading or directing effort, and may be thought of as involving identifying desired strategies (through the application of skills and knowledge), and implementing these through physical activities and technologies (see Burriss et al 2005). Consistent with this, in the adaptive governance literature 'management' almost always refers to situations of direct control over resources and the behaviour of agents, rather than situations where one agent or group of agents has influence or 'indirect control' over the decisions or behaviours of others (which would be generally refer to governance rather than management).

Advocates of adaptive management focus primarily on the first element of management – the identification of strategy – and draw attention to a range of uncertainties and potential pitfalls. These include: the importance of understanding system dynamics and relationships between system variables, that system thresholds may not be obvious before they are crossed (after which recovery may be difficult or impossible), that variability is an inherent and important feature of

ecological systems, and that resources and events are rarely distributed evenly through space or time (Holling 1978, pp.20, 25-26). This suggests (i) that future strategy should be based, at least in part, on lessons derived from review of the impact and effectiveness of past management actions, and (ii) that current management strategies should involve a degree of experimentation to reduce risks associated with current action and to improve the information base for future decisions. In practice, achieving these changes in management has required changes in governance, especially through changing the incentives for managers and the formal management structures.

Adaptation

Adaptation refers to an unmanaged, but systematic, process of change in response to competitive pressures.

In evolutionary theory, a species is adaptive if it has evolved in ways that promote the continued survival of the species under a variety of environmental conditions (through the reproductive success of individual organisms). A species that fails to persist is not adaptive. Adaptation is thus a spontaneous systematic process through which the performance of a species or organism is improved in relation to a specific criteria. Dawkins (1976) and others (Dennet 1995) argue these evolutionary processes will occur wherever characteristics replicated with variation and subject to selection pressure. Examples include the evolution of genes, ideas and culture (often described as memes, see Blackmore 1999), and institutions (Bowles 2003, Gintis 2003).

Changes in social systems are generally considered adaptive if they improve the efficacy of social arrangements – that is, if they enhance the satisfaction of the underlying needs and preferences of the people on which the institutions governance arrangements rely for their operation and legitimacy. The performance criteria for judging whether an institutional change is adaptive thus includes whether it promotes human wellbeing or the achievement of outcomes valued by humans, as well as survival of humans as a species.

Authors such as Holling et al (2002) and Walker et al (2006b) use similar terms slightly differently when they refer to ‘adaptive cycles’, which involve four phases of accumulation and release of resources (such as the variation in biomass in a forest periodically disturbed by fire). This generic cycle is observable in a wide variety of natural and human dominated systems. These authors also refer to the ‘adaptability’ of a system as the capacity of human actors to either prevent undesirable transformations of interdependent social and ecological systems, or promote desirable transformations (see Lebel et al 2006).

Adaptive governance

Adaptive governance thus refers to the ways in which institutional arrangements evolve to satisfy the needs and desires of the community in a changing environment. More formally, we define adaptive governance as follows:

Adaptive governance refers to the evolution of the rules and norms that promote the satisfaction of underlying human needs and preferences given changes in understanding, objectives, and the social, economic and environmental context.

A first important note is that the normative criteria used to judge whether a change in governance arrangements is ‘adaptive’ or ‘good’ are derived from the values and preferences of the constituency, rather than being imposed by the analyst. Much of the literature deals with ‘wicked problems’, however, where the criteria for evaluating options are themselves contested, and evolving in unpredictable ways (see Rittel and Webber 1973, 1984). Where this is the case – as argued by Arrow (1951) – values are revealed both through the institutions people choose through collective action, and by the choices they make as individuals.²

A second note is that the evolution of rules and norms does not need to be conscious or deliberative, or articulated in goal oriented terms, in order to be adaptive.

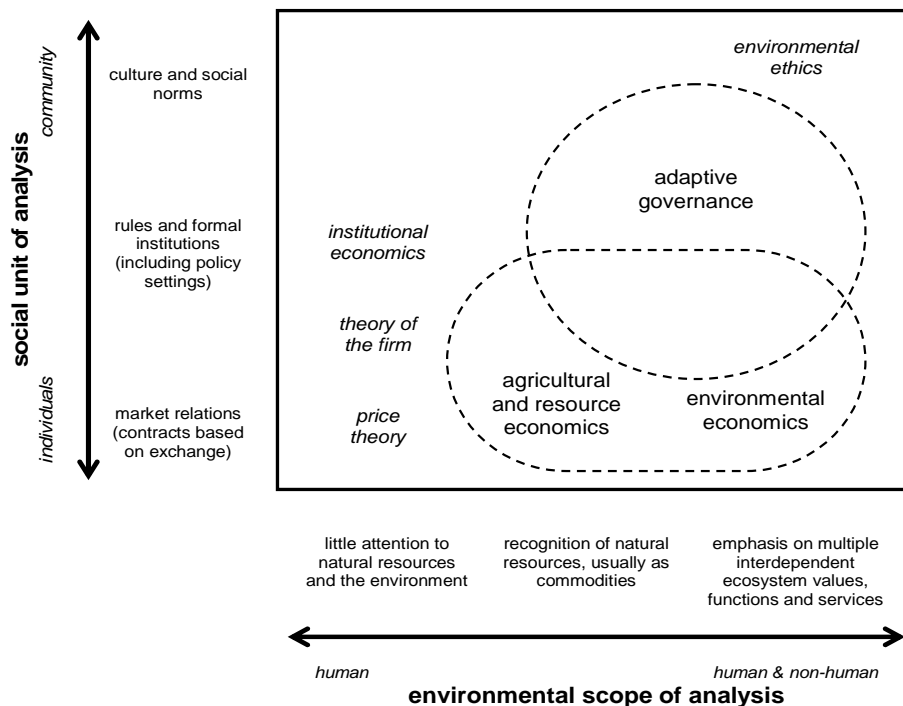
As discussed below, this implies that achieving improvements in the efficacy of institutional arrangements will generally require the development of collective action strategies that are both ‘efficiency enhancing’ and ‘adoptable’, providing net welfare gains (as conventionally defined) and being politically attractive within relevant decision structures and timeframes.

Section Three: Relationship to resource and environmental economics

It is clear from the discussion above that the adaptive governance literature draws heavily on concepts from economics, particularly resource and environmental economics, institutional economics, public choice perspectives on collective decision making, and evolutionary game theory. The adaptive governance literature complements economic theory, however, rather than seeking to replace it, and may be distinguished from economics in that it focuses primarily on how formal and informal institution shape social and collective behavior, rather how individuals and firms behave and ascribe value within markets and related legal arrangements (which are a specific set of institutions).

This relationship is illustrated in Figure 1, which locates resource and environmental economics and adaptive governance in terms of how they characterize environmental resources and the main social unit of analysis used.

Figure 1. Locating adaptive governance and resource and environmental economics



Source: Adapted from Hatfield-Dodds 1998

Section Four: Distinctive characteristics

We consider that the adaptive governance literature is best understood as an integrative empirically based approach to understanding the evolution of institutional arrangements for the management and use of shared natural resources. Although the literature draws on a wide range tools and methods, it is given coherence by the following distinctive shared assumptions.

- A.1 Social and biophysical systems are complex and adaptive, and evolve in ways that are not easily predictable (Holling and Meffe 1996, Gunderson and Holling 2002, Walker et al 2006b);
- A.2 Knowledge is imperfect and unevenly distributed across actors, particularly in relation to knowledge of resource availability and condition across time and location, and knowledge about the behaviour of other actors (Jiggins and Röling 2000, Ostrom 2005);
- A.3 Human evolution has resulted in people being mostly rational social actors, with ample but not infinite cognitive capacity, who evaluate options and pursue a mix of goals in contexts involving strategic interactions with other goal oriented actors (Gintis 2003, 2002a, Bowles 2003);³

- A.4 People apply different evaluation criteria to choices in different institutional settings, with behavioral experiments and other observations indicating that individuals generally conform to standard economic assumptions of self interested behavior in market circumstances, characterized by anonymous exchange, but behavior is more reciprocal or altruistic where institutions signal that non-market norms should be applied, where excessively self interested choices are more transparent to other actors, where there is more communication between actors, and there are more relationships and types of relationships between actors (Gintis 2000b, Frey 2001, Ostrom 2005, Schluter and Lee 1993);
- A.5 History indicates communities are able to develop sophisticated governance arrangements for common pool resources that provide differentiated rights and obligations in relation to access, benefit sharing and monitoring across different classes of user, and conserve the overall resource over long periods of time (Ostrom 1999). These arrangements may, however, be disrupted by changes in larger scale or higher level social systems (Ostrom et al 1999, Deitz et al 2003)

The literature also gives rise to a number of distinctive general insights:

- I.1 Self-governance is possible and often desirable (Ostrom 1999), in contrast to the common argument that externally imposed management is the best or only sustainable form of governance for common pool resources (see Hardin 1968);
- I.2 Contested governance (including overlapping regulatory scale and mandates) can have benefits as well as costs – particularly though encouraging more diverse perspectives on system process, and more attention to crafting approaches that satisfy multiple consistencies (with heterogenous values and interests) – in contrast to the view that ‘streamlined’ unambiguous management and governance arrangements are always desirable, or even achievable (Brunner et al 2005, Scholz and Stiftel 2005)
- I.3 Diverse types of knowledge can add value to governance and decision making through providing more diverse perspectives on system processes, reducing the risk of very poor management outcomes (Lebel et al 2006, Aslin and Brown 2004), although this may involve higher transaction costs;
- I.4 Devolution of responsibilities, rights and access to resources to heterogenous local management bodies can contribute to adaptive governance by improving access to local understanding of resource function and variability, promotion of innovation and experimental learning, stronger internal enforcement (through mutual observation and social incentives), and improved higher scale risk management through local redundancy (Ostrom 2005, Brunckhorst 2002);
- I.5 Improvements in efficacy of institutional arrangements will generally require the development of collective action strategies or policy proposals that are both worthwhile (efficiency enhancing, or able to provide net welfare gains) and adoptable (attractive to relevant decision makers, such as voters), drawing attention to the dual roles of knowledge in determining the extent of government’s ‘licence to govern’ (based on general public opinion) and informing the detail of specific decisions (through the creation of expert knowledge).

Although this literature was originally developed in the context of land tenure and management of well defined natural resources (particularly forest resources and irrigation water), we consider the insights and analytical tools generated are applicable to a much wider set of imperfectly excludable resources (including even diffuse notions such as collective trust or public good will, see Hatfield-Dodds and Pearson 2005), suggesting they have very wide utility and applicability. While it is not possible to explore the full range of these applications in this article, the accompanying articles by Nelson et al (2006) and Cook and Lonsdale (2006) explore the implications of A2, I3 and I4 for drought policy and more locally responsive approaches to managing invasive species, while Hatfield-Dodds and Bouilly (2006) explores insights from A5, I1 and I5 for the development of internally maintained governance that builds knowledge and commitment over time.

Section Five: Approaches to governing common pool resources

Much of the literature that has given rise to adaptive governance has been motivated by concern for the pathology of centralized expert management, also described as ‘command and control’ (Holling and Meffe 1996) and ‘scientific management’ (Brunner and Steelman 2005). This broad approach applies ideas that were originally developed for improving the efficiency of human-designed industrial production lines (see Taylor 1911) to the management of renewable natural resources such as fish, timber or fresh water. Unsurprisingly, this results in highly centralised top-down institutional arrangements that give little attention to the ways these resources are embedded in complex natural systems (Holling 1978, Ludwig et al 1993, Levin 1993, Dietz et al. 2003).

The central argument of the critics is that the application of ‘scientific management’ to natural systems is profoundly non-scientific. The complexity of ecological processes means that reductionist disciplinary study of system components will always struggle to provide useful insights into the emergent system-level properties of linked social and environmental systems (Holling 1978). It is thus not feasible to establish the knowledge base required to fully predict and control these systems (Jiggins and Roling 2000). In addition, disciplinary science culture and incentives often mitigate against whole-of-system approaches and administrative flexibility, and risk management goals and processes being shaped to serve the interests of scientists, rather than aligning science to support appropriate management (Brunner and Steelman 2005, see Nelson et al 2006 in this issue).

This focus on the problems associated with centralised expert management and the merits of adaptive governance results in a tendency to describe these approaches as two ends of a spectrum – at least in principle – while noting that in practice they may coexist at different scales or in relation to different aspects of natural resource management within a region (Brunner and Steelman 2005).

We consider this typology, while useful, risks obscuring two important things. First, these management approaches are characterised by differences across a range of attitudes and assumptions, as summarised in Table 1. This suggests a spectrum characterised by clusters of issues rather than a simple of continuum delineated by a single variable.

Second, and more important, adaptive governance affirms the messy middle ground, rather than advocating some utopian ideal. The literature has developed through careful empirical observation and reflection on the realities of muddling through. The adaptive governance critique of centralised expert management does not imply that resource management should be entirely decentralised and entrusted to non-experts. Rather, it argues that management practice has overshot, moving from one extreme to another. We thus think it is more useful to think of adaptive governance as sitting between two polar alternatives: centralised expert management and the romantic view that pre-industrial societies naturally lived in balance with nature. (For examples of these romantic views see Ruskin 1862 for a portrait of the noble agricultural village, and Rappaport 1986 for a spiritually attuned noble savage.) While these polar alternatives are flawed in different ways, they are united by their neglect of the nuance and complexity of human motivation and institutions, and the failure to recognise that all behaviour is influenced by implicit or explicit incentive effects.

Table 1. Overview of approaches to managing natural resources

Approach:	Centralised expert management	Adaptive governance	Romantic agrarianism (a)
Summary:	<i>Centralised uniform management based on biophysical science</i>	<i>Evolving multiple contested sources of governance</i>	<i>Decentralised resource management informed by tradition</i>
Assumptions:			
<i>Preferred knowledge base for managing natural resources:</i>	Silo based disciplinary expertise and scientific knowledge	Different types and sources of knowledge add value to decisions	Local traditional knowledge and customs
<i>Dominant motivation of individuals:</i>	Self-interest	Mix of reciprocal motives, favouring 'self regarding' and 'other regarding' motivations according to circumstances	Relationship oriented, prudent self interest with attention to community regard and status (b)
<i>Capacity for coordination:</i>	Individuals are uncooperative	Individuals capable of cooperation and self-oriented action	Individuals are usually cooperative
<i>Primary unit of governance:</i>	Central state agency based on scientific expertise	Multiple groupings and interests	Individuals embedded in community and tradition
<i>Source of authority and legitimacy:</i>	Externally imposed government powers and resources	Fluid multiple sources of support	Internal support expressed through tradition and custom May be supported by religion or spirituality
<i>Review cycle:</i>	Changes in strategy expected to be small and infrequent	Goals, context, knowledge and strategy are all fluid	Traditions provides timeless guidance for varying circumstances

(a) Romantic environmentalism is characterized by similar assumptions.

(b) Romantic environmentalism also emphasizes spirituality and honouring ancestors.

Ultimately, the task is to employ an analytical framework that matches the most important characteristics of the issue being addressed. Centralized expert management is likely to work well for engineering problems and tightly controlled systems (such as the factory production lines this approach was originally developed for), while romantic agrarianism may well be useful for resource management regimes with very high local social or ecological diversity and considerable resilience in relation to the dominant stresses. Adaptive governance has vital contributions in understanding complex and diverse systems that are undergoing major transformations or have low levels of resilience (see Walker and Salt 2006, Smajgl and Larson 2006).

Section Six: Insights into factors that facilitate adaptive governance

As outlined above, most of the adaptive governance literature has focused on governing the extraction of conditionally renewable resources that are embedded in complex adaptive social and natural systems. In very general terms, the literature examines the potential to restructure governance institutions so that resources shift from 'common pool' arrangements (rival but non-excludable) towards 'club good' conditions (where tighter definition of access allows monitoring of the general level of extraction by individuals).

This section illustrates the potential to apply some of these insights more broadly, including to policy issues involving the disposal of 'environmental bads'.

Many economists consider that citizen demand for environmental quality is a superior good, increasing with income, and argue that economic growth will thus tend to lead to improved

environmental quality over time (see Martínez-Alier 1995). Such improvements will generally require policy changes, however, due to the strong public good characteristics of environmental quality. This, in turn, relies on a three key factors: (i) environmental condition is visible, with well understood cause and effect relationships; (ii) the ‘environmental damage’ is reversible and subject to human influence; and (iii) the spatial and temporal scale of the problem allows arrangements to be crafted that result in perceived net benefits to key constituencies (see Arrow et al 1995).

Almost by definition, these conditions – particularly the last – do not hold for many of our most intractable environmental issues, such as dryland salinity or climate change. (Indeed, if these conditions did hold the issues would not be politically intractable.)

The key insight for economists and policy technicians is that policy adoption is governed by knowledge, attitudes, and political economy – all of which evolve over time. Knowledge motivates action and has moral influence (which sometimes leads people to avoid acquiring knowledge that may constrain their behavior, see Danna et al 2005). But more importantly, community engagement in decision processes impacts on the understandings and attitudes of those involved, which can expand the space for negotiation and agreement (Brunckhorst 2002, Brunner and Steelman 2005b, Hatfield-Dodds and Bouilly 2006).

This draws attention to different roles played by knowledge and ‘knowledge specialists’ – including economists, policy analysts, and biophysical scientists – in the formation of public policy. The first of these roles focuses on the political economy of policy change, which usually requires a problem to be demonstrated and accepted by the general public before governments can take decisive action. The second role of knowledge – particularly expert knowledge – is to inform the detail of specific decisions, once this ‘licence to govern’ has been established.

Concluding Comments: Insights for environment and resource economics

Our central argument is that the notion of adaptive governance is valuable to economists because it can help us to understand the factors that jointly determine the adoption of potential policy solutions we may design.

The adaptive governance literature complements and extends economics, providing a lens for analyzing the ‘adoptability’ of potential policy changes as well as their ‘efficiency’. It can therefore help improve our understanding of the market for one of our key products – policy recommendations – and help us to be more effective in our engagement with policy issues. A specific insight for researchers (and other ‘knowledge workers’) is that they play two distinct roles in assisting the resolution of socially contested decisions. The first is to contribute to a social process of consensus building around the need – or otherwise – for collective action. This underpins the political ‘license to operate’ necessary for action on contentious issues. The second is more familiar to economists and policy advisors, and focuses on providing more technical advice that helps inform the details of how to best implement that mandate.

While it is distinctive, the adaptive governance literature also shares substantial common ground with essential tenets of economics. Individuals are considered to be essentially rational actors who pursue a mix of goals in decision environment that includes other independent strategic actors. Decision environments – such firms, markets, and regulatory bodies – evolve over time in response to competitive pressures and resource feedbacks. Information is frequently imperfect and unevenly distributed. Values also vary across individuals and groups.

The literature also provide a useful integrative framework for the analysis of policy issues, providing bridges to related disciplines (such as public choice, experimental economics, and behavioural psychology) while maintaining a coherent intellectual core.

We thus conclude that the notion of adaptive governance has the potential to play a role akin to the concept of market failure within economics, but applied to institutional dynamics and associated processes of social learning and collective choice. Coupled with economics, this could make a powerful contribution to understanding a wide variety of impediments to responsive public policy, and assist the development of effective options for addressing different types of market and institutional failures which would otherwise impede the development and implementation of welfare-enhancing policy options

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¹ A search using SCOPUS querying title, abstract and key word fields carried out in September 2006 identified 89 articles. Of these, 58 articles were considered to be related in some way natural resource governance or adaptive governance more broadly, including 46 in environmental science journals. Two books were identified separately through an internet search.

- ² Scholz and Stiffler (2005:5) argue that the resolution of contested values is central to the notion of adaptive governance, particularly the reduction of second order conflict between regulatory agencies with various forms of overlapping jurisdiction: “Adaptive governance ... involves the evolution of new governance institutions capable of generating long-term, sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities and organized interests.”
- ³ For a contrasting view see Ludwig et al (1993), who argue that human governance is fundamentally maladaptive, and assert that humans are not capable of managing natural resources without causing ecosystem collapse – a proposition that attracted lively debate in a special edition of *Ecological Applications* (see Levin 1993).