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Structural-functionalism redux: adaptation to climate change and the challenge of a science-driven policy agenda

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ABSTRACT

Most efforts to develop a comprehensive, science-based approach to climate change adaptation have been written by natural scientists and resource managers and have adopted an underlying conception of policy-making as a functional process of mutual adjustment between elements of tightly linked natural and social systems. The influence of this framing is especially clear in the popularity of key metaphors such as 'stress,' 'barriers,' 'vulnerability,' and 'resilience.' There are obvious advantages to this way of proceeding, not least the possibility of using the systems concept as an overarching framework to integrate the multidisciplinary teams of researchers commonly employed in large-scale assessments of climate change impacts. Nonetheless, this underlying conception of linked natural and social systems presents significant challenges when it comes to moving the ideas found in these strategic documents forward into the world of policy and practice. As the case studies of North American, Australian, and European studies presented here show, the strategic documents themselves are very short on policy analysis, fail to incorporate the impact of institutions and policy legacies into their analyses, and, as a result, favor unfounded or infeasible management prescriptions. As a consequence, adaptation policy itself remains poorly developed in most jurisdictions.

KEYWORDS

Policy; structural functionalism; climate change; adaptation

1. Introduction: adaptation studies and their policy presuppositions

Many, if not most, of the current efforts at developing comprehensive, science-based approaches to climate change adaptation have adopted an underlying conception of adaptation as a process of mutual adjustment between elements of tightly linked natural and social systems. This mode of analysis has tended to reduce political and other aspects of policy-making to 'functions' of larger social systems in which problems originating in the natural sphere are assumed to generate 'appropriate' responses in the policy realm. This functional logic lies behind the strongly felt belief of many scientists, for instance, that policy-making responds to evidence in a clear and direct fashion and that their findings in the area of climate science, to give only one example,

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should automatically be translated into policy recommendations and outputs (Rudd 2015; Rose and Parsons 2015).

This article examines the ways in which the analyses of adaptation policy in Australia, Canada, the United States, and the European Union have been encumbered by these functional presuppositions and the linear aspirations of climate change scientists to develop policy directly on the basis of science-based assessments, at the neglect of policy-relevant variables clearly specified in the policy studies literature. As the case studies presented below show, introducing high-level systems modeling with an underlying functional explanatory logic and a linear notion of knowledge utilization directly into policy analyzes without first examining the extensive literature in disciplines such as economics, political science, and sociology, whose contemporary development has been marked by a rejection of such functional logics and linear thinking (Wellstead, Howlett, and Rayner 2013, 2014; Biesbroek et al. 2015), is highly problematic.

We focus here on the challenges posed by the adoption of this logic in many studies and policy recommendations informing efforts to enhance climate change adaptation policy innovation, using examples from practices followed in the forest sector. As the case studies from this sector show, throughout North America, Australia, and Europe adaptation strategies and frameworks contain the language of, and are heavily influenced by sustainability systems theory (SST) and are often couched in interdisciplinary terms driven by a logic that assumes policy responses ought to occur automatically in response to crises and other system level events and that policy recommendations should (and do) flow directly from the insights of climate science.

Such a functional logic and linear theory of knowledge utilization is incompatible with the findings of the policy sciences where much more contingent and fraught policy processes have often been found to exist even in the face of extreme and universally acknowledged crises such as war or economic collapse (Elster 1983). Given the actual nature of policy-making, policy scientists argue there is a need to examine policy-making behavior both at the micro-level of individual analyst and decision-maker rationality and at the meso-level of the institutional and other constraints affecting consideration of issues and solutions (Kingdon 2011; Clemens and Cook 1999). Following purely macro-level functional approaches fails to connect causes and effects within and between organizations and policy actors because they do not identify and take into account critical mediating mechanisms involved in policy-making such as institutional structures and actor behavior. That is, when applied to social and political life, SST describes 'normal' political activity as taking place through automatic feedback loops in which external perturbations in policy environments 'necessarily' cause internal reactions and alterations required to re-establish equilibrium, albeit often at a new level (Stinchcombe 1987; Elster 1979, 1983).

Such feedback-driven homeostatic descriptions of policy processes, while perhaps appropriate in some biological or ecological instances, fail to explain social and political change (Elster 1985). This is both because in social and political life there are many examples of singular, nonrecurring events that produce unintended policy consequences (such as wars, riots, and rebellions) and result in nonlinear policy dynamics (Baumgartner and Jones 2002), and also because it is common in such analyses to postulate or assume automatic feedback loops when they do not in fact exist (Elster

1983; Chilcott 1998; Fischer 2010). Thus, a lexicon highlighting such concepts as adaptive capacity, resilience, robustness, vulnerability, and complex adaptive systems has emerged from systems science to color many analyzes and policy recommendations across many sectors and issue areas but without the requisite understanding of actual policy-making dynamics and processes which would allow the construction of feasible policy alternatives and options. Although the structural functionalist understanding of a complex social-ecology has a broad appeal, its ability to inform and predict policy outputs and outcomes is limited and misleading, even as a heuristic device.

This is very much the case with forest vulnerability assessments and the adaptation frameworks in this sector highlighted below. These show how adherents of SST and other high-level approaches to climate change adaptation assume institutions and policy-making behavior will always generate policies or management prescriptions that will produce beneficial results in systems under duress from natural events such as global warming, despite all evidence to the contrary (Howlett 2014).

2. The limits of adaptive systems theory as a policy framework

The influence of systems influenced policy problem and solution framing is apparent in many climate change adaptation reports which feature metaphors such as 'adaptive capacity,' 'stress,' 'resilience,' and 'vulnerability.' These terms and concepts are found in many adaptation assessment, frameworks, and studies in the forest sector and elsewhere and heavily influence the kinds of recommendations and prescriptions for government action which these reports contain.

What is often ignored in the assessment and reception of these studies is the underlying conception of linked natural and social systems which forms the foundation of such concepts and informs their use. These presuppositions, however, present significant challenges when it comes to moving the ideas found and promoted in these strategic documents – such as 'overcoming barriers' to adaptation – forward into the world of policy and practice (Robbert et al. 2014, 2015).

In the first instance, these studies promote a functional view of politics and policy-making, ignoring the vagaries of decision-making behavior and the organizational use of knowledge, generating proposals for alternative courses of action which ignore basic political facts on the ground. This is true of many studies which, for example, ignore critical factors such as the division of powers found between levels of government in federal systems which can prevent governments from acting in many areas as expected or recommended. It is also true of studies which ignore the impact of policy legacies in creating constituencies in favor of perpetuating the status quo, and the risk- or blame-averse behavior of politicians in democratic societies (Howlett 2014) which can also prevent or hinder the adoption of policy recommendations and courses of action.

Second, these studies are also often informed by a related view of the unproblematic nature of the translation of policy-relevant knowledge into policy recommendations and practice (Rose and Parsons 2015). The expectation that governments are heavily evidence-based and rely on scientific findings to inform policy-making again flies in the face of much evidence to contrary in policy studies (Pawson 2006; Tenbensel 2004; Cherney et al. 2012; Pearce, Wesselink, and Colebatch 2014) but is omnipresent in vulnerability studies.

In the next section, we review the theoretical basis of a number of adaptation reports in this sector and establish the family resemblances between the integrated systems approaches and the knowledge utilization theories that underlie them. The American, Australian, and Canadian strategic documents examined herein display these problems very clearly. In particular they are very short on policy analysis and favor generic management prescriptions – such as ecosystem management – which are assumed to be largely unproblematic policy strategies in terms of adoption and implementation. This is similar to the German and Finnish frameworks examined below although these do contain policy directives tied to the EU climate change planning process which are more aware of the significance of political and institutional variables in policy-making activity. In both instances the unrealistic and inaccurate assumptions made about policy processes and knowledge utilization in government contribute to adaptation policy itself remaining poorly developed in most jurisdictions.

Our conclusion is that a greater appreciation for the significance of political and institutional variables in policy-making and knowledge utilization is needed if climate change outcomes are to be improved. A much better understanding of these processes and better models and forecasts are needed to replace the exclusive use of systems-inspired logic in most existing vulnerability studies. More importantly, at an applied level, an enhanced appreciation of the institutional and politics dynamics and forces behind policy-making will result in more realistic strategic frameworks better able to support decision-makers in their own work and help both academics and practitioners better understand and overcome the sources of policy failures (Biesbroek et al. 2015).

3. Sustainability systems theory (SST), integrated systems modeling, and adaptive strategy construction in the forest sector

Strategic assessments for adaptation are often conducted at a national or subnational multisectoral level and we have chosen to focus on a single sector, following the general consensus in the contemporary policy literature that policy-making processes have distinctive sector-specific characteristics (Howlett, Ramesh, and Perl 2009).

The forest sector has been chosen for detailed analysis because it has been particularly affected by recent high profile climate change related events such the Mountain pine beetle (*Dendroctonus ponderosae*) infestation (Canada), wildfires (US), hurricanes (Germany), and droughts (Australia). It also boasts a highly developed scientific expert community in all these countries as it does in the other EU cases examined (Linder et al. 2010).

These expert professional communities take the problem of adapting forests to a warmer, drier world very seriously. More significantly, in all five countries, there is extensive public ownership of forested lands and well-developed policy capacity at a variety of levels.[1] National and state forest agencies in each country have invested considerable resources examining forest-related climate change impacts and developing adaptation policy frameworks which they reasonably expect should be able to affect public policy decision-making processes and outcomes. If integrated systems modeling can produce effective adaptation policy anywhere, then the forest sector in these five jurisdictions is an ideal candidate.

As is shown below, the use of integrated natural and social science modeling is very common in this sector, and concrete proposals for adaptive management strategies are also well established in these studies and models.

3.1. *The non-politics of sustainability science: SST, CHES, CHANS, SES, and CAS*

Although there are several variants, the umbrella term 'sustainability science' is now in general use in forest sector vulnerability and adaptation studies. It attempts to combine the distinctive social, environmental, and ecological elements of the sustainability paradigm into a single explanatory framework which can provide prescriptions for adaptation efforts (Turner 2010). The particular variants of sustainability science that have been used in the sector and which thus concern us here include coupled human environment systems [CHES] (Turner and Robbins 2008), coupled human and natural systems (CHANS) (Alberti et al. 2011), social ecological systems (SES) (Berkes, Colding, and Folke 2003), and complex adaptive systems (CAS) (Holling 2001; Folke et al. 2002).[2] We refer to these theories collectively as SST.

Holling states the fundamental shared insight of all SST approaches very clearly: 'the complexity of living systems of people and nature emerges not from a random association of a large number of interacting factors [but] rather from a smaller number of controlling processes. These systems are self-organized, and a small set of critical processes create and maintain this self-organization' (2001, 391).

SST has been rapidly transformed from a theoretical framework into a leading policy discourse, institutionalized through the work of the UN-based Intergovernmental Panel and Climate Change (IPCC) (Figure 1) and the various coordinating bodies –

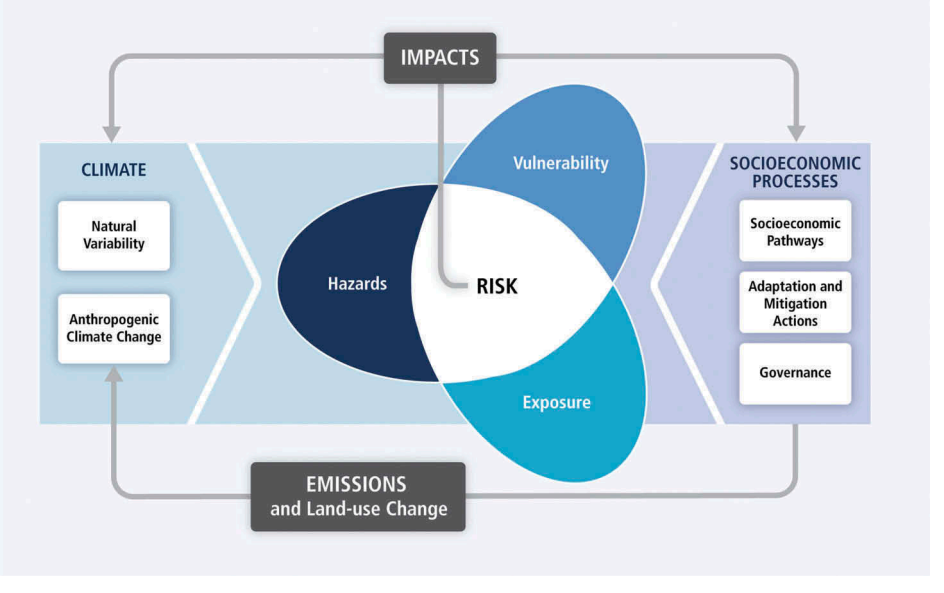

Figure 1. Core concepts of the WGII AR5 (from IPCC 2014).

intergovernmental, interdepartmental, and interorganizational – set up to create and implement national and regional adaptation strategies based on the IPCC's work.

The focus of SST on identifying the critical processes of self-organization is exemplified in the characteristic functional 'box and arrow' diagrams found in sustainability systems science-influenced studies (see for example Adger, Lorenzoni, and O'Brien 2010; Füssell and Klein 2006). Variations on this fundamental idea also provide the key concepts of adaptation, adaptive capacity, vulnerability, and resilience, which dominate the policy debate and discussion invoked by SST adherents and are found in key policy documents such as framework and assessments.

The capstone of the whole approach is the IPCC's Working Group II (Impacts, Adaptation, and Vulnerability) contribution to the IPCC's fifth assessment report, which begins ' [h]uman interference with the climate system is occurring, and climate change poses risks for human and natural systems'(IPCC 2014, 3). WG II goes on to assert that a more comprehensive 'knowledge base' accessed by the working group 'has facilitated comprehensive assessment across a broader set of topics and sectors, with expanded coverage of human systems, adaptation, and the ocean.' Country studies either directly acknowledge the lead taken by WGII, are coordinated by scientists involved in the IPCC's working groups or adopt their own SST approach. The common feature of all these studies is a general neglect of real practices of governance and policy-making in their own jurisdictions in favor of a vision of these processes occurring as 'feedback' from social to natural systems.

The IPCC's Working Group II (Impacts, Adaptation, and Vulnerability) assessment reports in particular have provided the structural blueprint for national and forest sector frameworks and assessments using SST concepts and ideas. The chapters co-authored by leading scholars in the climate change field have developed these concepts which in turn have influenced on-the-ground policy efforts.

In the 4th Assessment, Adger et al. (2007, 727), for example, state that adaptive capacity, the core concept,

> is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behavior and in resources and technologies. The presence of adaptive capacity has been shown to be a necessary condition for the design and implementation of effective adaptive strategies so as to reduce the likelihood and the magnitude of harmful outcomes resulting from climate change.

'Adaptation' to climate change is portrayed in these studies as occurring on its own accord (reactive or autonomous) in a quasi-naturalistic process of alteration to changed circumstances, much as occurs in a forest or lake affected by climate change.[3] According to the existing adaptation literature, broad management prescriptions which follow from this analysis can include anticipatory and reactive actions (Adger et al. 2007) and can be autonomous or planned (Seppälä, Buck, and Katila 2009).

Adaptation, however, is problematic as a policy goal or response for several reasons. First, there are few, if any, ecosystems that are not strongly influenced by human activities, such as when logging or agriculture disturbs a forest or watercourse. The question is thus not to simply allow adaptation to take its own course, but how to effectively plan for it. And, second, many activities are designed to produce a range of benefits – from pulp and paper products to aesthetics and recreation in the case of forests – that societies would like to continue to enjoy despite climate change. Some of

these benefits have monetary value in markets while others, including many aesthetic and ecosystem services ones, do not meaning a variety of tools and techniques are needed to achieve them.

In the EU, Massey and Bergsma (2008) found that the overall level and state of adaptation policy was in general 'quite low', without any specifically-targeted policy measures in place. Large-scale national and sectoral frameworks and assessments have thus been considered the first step towards enhanced anticipatory and planned approaches to climate change adaptation (Swart et al. 2009; Dumollard and Leseur 2011; Bierbaum et al. 2013, 2014; Lemieux et al. 2013) but these continue to contain assumptions and presuppositions about policy processes which severely limit their effectiveness and impact.

4. The forest case: Australia, Canada, the US, EU, Finland, and Germany

Currently in forest sector studies, a range of policy instruments is promoted to attain adaptation goals. Tools suggested to be used to keep forests in place, for example, include wilderness and parks designations, forest land tenures, conservation tax incentives, and many others.

Exactly how to develop effective adaptation policies in order to maintain the benefits provided by forests thus involve the consideration of a very wide range of factors and well-informed analysis of biophysical systems, but also considerable policy uncertainty. It is understood in these studies that natural autonomous adaptation of forests to climate change will affect existing policy regimes as land uses and speciation change, requiring revisions to existing commercial and other arrangements and new trade-offs between different products, services, and land uses. However, it is argued that some of these processes can be slowed or delayed, or their impact and effects altered by planned and anticipated government action – such as reforestation with drought-resistant species of trees, increasing the amount of timber from salvage logging of fire- or insect-disturbed stands, or reducing the rotation age followed by planting to speed the establishment of better-adapted forest types (Spittlehouse and Stewart 2003).

'Policy' in these studies is thus understood as an institutional requirement for adaptation to occur that flows naturally in facilitating natural science-informed climate change initiatives (Adger et al. 2007, 731). The 5th ICPP Assessment, for example, argues that adaptation is a system-level function which maintains the existing technological, institutional, governance, and value systems (Noble et al. 2014, 839). Moreover, in this report 'governance' is seen as a mechanism necessary to enhance adaptive capacity (Noble et al. 2014, 849). Polices are to be developed in a 'risk-based' (Figure 2) framework which is expected to simply overcome 'structural constraints' including physical, biological, economic, human resources, social and cultural, and finally governance and institutional ones (see Klein et al. 2014; Mimura et al. 2014).

What is often ignored in the growing literature dealing with and recommending policy, is that recommended policies may not be uncontroversial and their adoption is not automatic or evidence-based (Brooks, Adger, and Kelly 2005; Lebel et al. 2006; Norris et al. 2008; Brown 2009; Gupta et al. 2010; Termeer, Dewulf, and van Lieshout 2010; Keskitalo et al. 2011). As the policy sciences have noted, there are distributional consequences to any policy choice and assembling information, framing policy problems and analyzing options to address them are all contested activities featuring many actors and

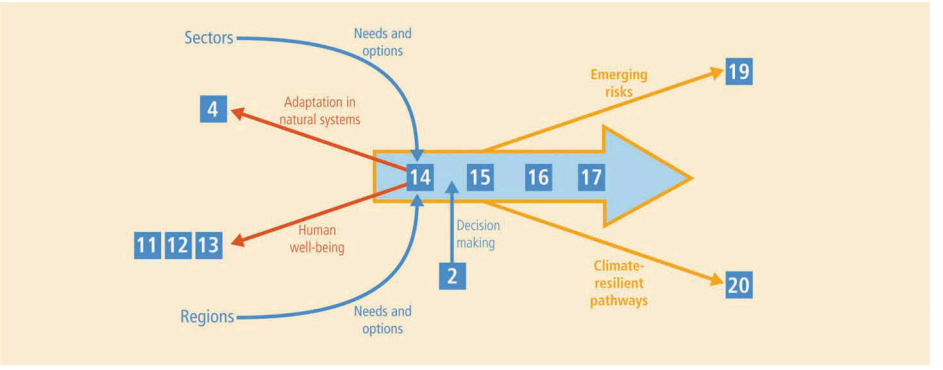

Figure 2. WGII AR5 risk-based framework (from Noble et al. 2014).

players in both governmental and nongovernmental settings (Howlett, Ramesh, and Perl 2009). Some of these actors can expect to be winners and others losers and their use of information and knowledge will vary directly in terms of its instrumental, strategic, or informative potential and impact (Tennøy et al. 2015; Entzinger and Scholten 2015).

Policy scholars have dealt with these realities for decades (Whiteman 1985; Weiss 1986) but their insights are rarely acknowledged or incorporated into adaptation studies. Recently, for example, the authors conducted a bibliometric study of peer-reviewed papers from 2005 to 2015 investigating vulnerability assessments and adaptation frameworks. Of the 2500 papers initially referencing policy, only 24 incorporated policy theory (see also Upham and Dendler 2015).[4] Consequently, on-the-ground adaptation policy thinking and analysis have failed to consider such factors when projecting future scenarios and recommending how to deal with them. However, if this work is to have any chance of successfully influencing policy-making behavior and outcomes in the desired direction, it must address these issues head-on.

Each of the national governments selected for study below have, with the assistance of leading climate change specialists, commissioned ambitious climate change vulnerability assessment and adaptation frameworks at both the broad national and the forest sector levels (Table 1) which use this framework. These share a common stated purpose of identifying climate change related impacts and vulnerabilities and then offering solutions that will enhance adaptive capacity. These well-meaning documents detail key indicators and propose a plethora of management options or innovations that they argue *ought* to become policies. Each share the stated importance of building adaptive capacities, which itself is a manifestation of functionalist logic. Here the drawbacks of an SST approach to adaptation planning and strategizing start to become very evident. In Australia, Canada, and the United States, whether or not these recommendations have any chance of becoming policies, for example, is never assessed.

4.1. *Australia*

In Australia, following the 2007 Climate Change Adaptation Framework, the National Climate Change Adaptation Research Facility (NCCAR), a partnership with the research community funded by the Australian federal government undertook a number

Table 1. Multilevel assessments.

	Australia	Canada	United States	Finland	Germany
International	Working Group of the Intergovernmental Panel on Climate Change UN Framework Convention on Climate Change				
Supra/National framework	2007 National Climate Change Adaptation Framework	2014 Federal Adaptation Climate Change Framework	The President's Climate Action Plan	The 2009 White Paper 'Adapting to climate change: Towards a European framework for action' 2013 EU Strategy on adaptation to climate change	
				2005 National Strategy for Adaptation to Climate Change	2008 German Strategy for Adaptation to Climate Change 2011 Adaptation Action Plan of the German Strategy for Adaptation to Climate Change
National assessment/ evaluation	2007 National Climate Change Adaptation Research (NCCAR) Facility 2013 Climate Adaptation Outlook a Proposed National Adaptation Assessment Framework	2014 Natural Resources Canada 'Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation'	The Third National Climate Change Assessment 2010 Progress Report of the Interagency Climate Change Adaptation Task Force	Evaluation of the Implementation of Finland's National Strategy for Adaptation to Climate Change 2009	
Forest Sector framework/action plan	2010 NCCAR Socio-economic implications of climate change with regard to forests and forest management. Contribution of Work Package 3 to the Forest Vulnerability Assessment	2013 Canadian Council of Forest Ministers 'A Framework for Assessing Vulnerability and Mainstreaming Adaptation into Decision Making'		EU Forest Strategy The Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry 2011–2015	

of vulnerability assessments. The NCCAR was initiated in order to 'provide information to assist governments, natural resource management managers and the business sector to adapt to the changing climatic environment in a manner consistent with principles of sustainable forest management' (Cockfield et al. 2011).

A recent output of this effort was, 'An Assessment of the Vulnerability of Australian Forests to the Impacts of Climate Change.' This four-report assessment by leading Australian climate change scholars is directly based on the IPCC WG III's approach to assessing adaptation practices, options, constraints, and capacity. But in their report, 'Climate change adaptation options, tools and vulnerability,' Wilson and Turton (2010) claim very little is understood about governance mechanisms and the subject is sparingly discussed.[3] When it is mentioned, governance is treated simply as a variable that constrains adaptive capacity. Thus the assessment stated vaguely that 'with regard to forests and forest management accelerating impacts may lead to classic paradigmatic change but [also] the need for the adaptive governance of social-ecological systems' (Wilson and Turton (2010, 31). The 2013 Climate Adaptation Outlook: A Proposed National Assessment Framework does not discuss the forest sector. Its assessment framework consists of 'good' drivers that would be facilitated by appropriate activities leading to acceptable or manageable risk outputs. Governance is treated as one of these drivers.

4.2. *Canada*

In Canada, there have been three national level climate change adaptation assessments (2004, 2008, 2014) that were prepared by leading climate change experts in response to earlier programming and research efforts led by the Canadian federal government's Department of Natural Resources (NRCan) and Environment Canada following the 1997 Kyoto Protocol commitments made by signatory countries to reduce greenhouse gas (GHG) emissions. The 2008 assessment, led by NRCan, drew its analysis from earlier functionalist-based contributions, namely Smit and Wandel (2006), as well as resilience studies, such as Adgar (2006), Folke (2006), Gallopín (2006), and Nelson, Adger, and Brown (2007).

The adaptation framework they adopt is pitched at a very high level of generality and attempts to model relationships existing among various ecosystem elements related to measures such as exposure, sensitivity, impacts, adaptive capacity, vulnerability, and adaptation at the macro or systems level. The level of generality is clear even in the definition of 'adaptation' used in these models, which refers to 'the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.' Similarly, adaptive capacity is concerned with 'the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences' (Füssel and Klein 2006, 18).

Füssel and Klein's functional model is specifically applied in the intergovernmental Canadian Council of Forest Ministers (CCFM)'s Task Force 'A Framework for Assessing Vulnerability and Mainstreaming Adaptation into Decision Making' (Johnston and Edwards 2013). Similar to the Australian effort, the 'primary goal' is providing 'the forest sector with state-of-the-art tools and new knowledge that will

allow them to assess the vulnerabilities, risks, and opportunities associated with climate change.' One of the outputs, very similar to the Australian approach, is 'A Framework for Assessing Vulnerability and Mainstreaming Adaptation into Decision Making' (Johnston and Edwards 2013).

The CFFM framework specifically employs the SST concept of adaptive capacity, which is defined as the ability of a system to adjust to changing internal demands and external circumstances. Moreover, adaptive capacity in the CCFM framework is 'represented as a function of specific determinants such as the effectiveness of institutions, the availability of technological options, the availability of human and social capital (e.g. skills, education, experience, and networks), information and information management, financial resources and natural capital, and the capacity for risk management' (Williamson, Hesseln, and Johnston 2012). The framework also highlights adaptive capacity deficits that are the results of factors causing under- or over-investment in adaptive capacity 'assets' that may arise due to market, governance, institutional, and social system failures (Williamson, Hesseln, and Johnston 2012).

Again, as in Australia, governance and policy dynamics in the forest policy sector are treated not as major independent determinants of policy content but simply as additional functional input variables that need to be manipulated in order to positively affect adaptive capacity outcomes. In part driven by the CCFM efforts, provincial governments are also developing forest adaptation frameworks featuring the same problems. For example, in British Columbia, the Forest Stewardship Action Plan for Climate Change Adaptation and the Ministry of Forests, Land and Natural Resource Operations' (FLNR) Climate Change Strategy reveals little about concrete policy development. The focus of both approaches has been about setting management priorities, developing organizational leadership, enhancing education, facilitating partnerships, and assessing vulnerabilities without regard to the nature of policy institutions and knowledge processes in government.

4.3. *United States*

In the United States, the USDA Forest Service has followed the same 'vulnerability assessment framework' path by developing a 'Strategic Framework for Responding to Climate Change' and a 'National Roadmap for Responding to Climate Change.' These strategies were also the result of comprehensive vulnerability assessments (USDA Forest Service 2010). However, unlike the Australian and Canadian cases, the US Forest Service also implemented a 'Climate Change Performance Scorecard.' Implemented in all National Forests and Grasslands, it would report on-the-ground accomplishments and plans for improvement in four 'dimensions' – organizational capacity, engagement, adaptation, and mitigation (USDA Forest Service 2011). Within the adaptation dimension, vulnerability assessments would 'assess the vulnerability of key resources to the impacts of climate change and the interaction with other stressors and human communities.' Again, however, despite its pivotal role in subsequent policy specification and adoption, discussion or detailed analysis of the role of government and governance in policy-making and policy outcomes is notably absent from this document.

4.4. *The European Union*

The SST language is, but to a lesser degree, also present in the EU's broad policy documents. For example, the object of the EU's 2009 White Paper 'Adapting to climate change: Towards a European framework for action' was to 'improve the resilience to deal with the impact of climate change' (EU Commission 2009, 7). The two-phased approach recommended beginning in 2009 to include integrating adaptation into EU key policy areas and employing a combination of policy instruments to ensure its effective delivery (EU Commission 2009). Key to the 2013 EU Adaptation Strategy was promoting national climate change adaptation strategies as recommended by the UN Framework Convention on Climate Change. Central to the Strategy was assistance to help individual member countries develop, implement, and review adaptation policies. Moreover, the Commission would provide Financial Instrument for the Environment (LIFE) funding to support capacity building and step up adaptation action (EU Commission 2014). For example, sustainable management of forest fires in drought prone areas was identified as a vulnerable area. At the sector-level, the 2013 EU Forest Strategy was designed in order to assist in coordinating and ensuring the coherence of forest-related policies (EU Commission 2013, 4). This strategy, of course, was more sensitive to policy and governance considerations than most such studies but nevertheless thin on recommendations for how this was to occur in individual member states. Two of the most heavily forest industry oriented of these are examined below.

4.5. *Finland*

Like the North American assessments, Finland's first national strategy for adaptation to climate change was prepared in 2005 and focused largely on the impact on various sectors and natural sectors. An 'Evaluation of the Implementation of Finland's National Strategy for Adaptation to Climate Change' was conducted in 2009 and called for the development of long-term climate policy and for a clear plan on how to ensure the access to sufficient information and resources for the implementation of adaptation to occur (Ministry of Agriculture and Forestry 2009, 17). On March 6, 2015, the Finnish Parliament passed the Climate Change Act. Although focused on emissions reduction, the Act called for ongoing adaptation planning. At the forest sector level, the Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry 2011–2015 lists 10 policy measures addressing Finnish forest management. For example, impacts of climate change 'are to be taken into account in amending the legislation on preventing insect and fungus damages in forests' (Ministry of Agriculture and Forests 2011, 8).

4.6. *Germany*

The 2008 German Strategy for Adaptation to Climate Change provided an overview of the impacts of climate change and possible management solutions to a number of sectors, including forestry. The Strategy recommended the preparation of the 2011 'Adaptation Action Plan of the German Strategy for Adaptation to Climate Change' that would be given the 'task of giving more concrete shape to further strategic activities' (German

Federal Government 2008, 54). The second pillar of the 2011 German Action Plan focused on policy-making and called for including adaptation requirements in legal provisions as well as integrating the requirements of adaption into standards and bodies of technical rules and funding. The federal government recently established the UBA KompPass (a sub unit of the Federal Environment agency) to 'develop the German Adaptation Strategy (DAS) and promote its implementation' (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2012). The importance of the forest sector is mentioned in both the Strategy and Action Plan, but Germany does not have a national sector-based adaptation to climate change framework. Keskitalo et al. (2015, 37) found that the development of adaptation policies was driven by the 'general concerns of the German environmental community rather than foresters'.[5]

5. Analysis

Policy innovations are changes to existing policy practices, which introduce novel practices and often result in new outcomes (Polsby 1984). Understanding policy innovation requires looking not only at the natural systems that are the sources of potentially problematic situations but also at the political and institutional factors that transform situations into problems and attempt to address them (Massey et al. 2014). Unfortunately, the functionalist SST framing found in the climate change adaptation literature and subsequently in many adaptation reports overlooks many of the basic realities of policy-making, from the institutional limits of government in federal states to poorly modelled assumptions about policy-makers motivations and behavior in both knowledge utilization and policy-making more generally. The poorly developed state of adaptation policy (in contrast to the proliferation of strategic documents about the need for adaptation) underscores both the problems with the existing field and the need to do better (Biesbroek et al. 2015).

This is readily apparent in the forest sector assessments and adaptation studies and recommendations made in Australia, Canada, and the United States. There SST and IPCC-inspired adaptation frameworks have all failed to address many significant policy-related variables in assessing concepts such as vulnerability and promoting and recommending various ways to improve resilience or increase adaptive capacity. European studies are more policy-aware but still suffer from the same general orientation towards policy-making as a functionally-adaptive system.

This is true not just with respect to ignoring key institutional aspects of policy-making but also in terms of concerns and behavioral patterns in policy-making other than problem recognition and response. The existence of alternate areas of interest and the opportunity costs associated with an exclusive focus on climate change related issues, for example, is unexamined and unexplored in forest sector assessments. Although the policy sciences have documented how risk avoidance strategies rather than evidence-based ones have largely dominated climate change and many other areas of policy-making (Hood 2010; Howlett 2014), such insights are ignored in vulnerability and adaptation studies. The failure of substantive climate change policy innovations to appear in many jurisdictions thus is less a result of program or process failures which undermine government 'goodwill' or serve as 'barriers' to automatic or 'functional' adaptation, but rather are the result of a common political calculus employed by decision-makers.

In many cases, for example, the failure of substantive policy innovations to appear at all (even before we can consider whether they actually work in practice) is the result of a 'negativity bias,' on the part of decision-makers (Hood 2010). A desire to avoid blame for failures can lead policy-makers to first deny a problem, then attempt to avoid any action in response to it and only when forced to do so, to undertake as little action as possible, including, very often, continuing to deny a problem exists and attacking and resisting proponents of policy change (Howlett 2014).

Similarly, partnership structures between governmental agencies and societal groups are a standard procedural policy instrument employed by government agencies in countless environmental policy-making settings (Hermans, Naber, and Enserink 2012). The justifications for such partnerships are well known, including the limited capacity of the lead organization, overlapping jurisdictional responsibilities, and as a mechanism for public involvement and policy legitimation. The blame avoidance affects of such arrangements, however, is to limit the political risk of identifying a single organization as being responsible for a particular decision.

For example, the NCCAR was established in 2008 under the National Climate Change Adaptation Framework agreed to by the Council of Australian Governments. NCCARF is a partnership between the Department of Climate Change and Energy Efficiency and Griffith University, with a consortium of other Australian universities as funding partners. While it is admirable that such a range of expertise has been collected under one roof, this also tends to disperse responsibility and lead to consensus-type decision-making subject to many veto points, leading to anodyne conclusions and recommendations and avoiding allegations of blame and responsibility.

Equally, the operational strategy of 'herding' is another familiar strategy whereby the overall risk for individual agency blame is reduced. Climate change adaptation frameworks often contain benchmarking activities made by a number of people, again often through a consensus process. Some common examples include criteria and indicators, good governance indicators, best practices manuals, foresight activities, or future management recommendations which all contribute some elements of blame-avoiding behavior by spreading the risk for error among a collective grouping.

None of these policy-maker behaviors, or any others, are modeled or included in adaptation studies (Armitage and Plummer 2010) which continue to rely on functional logics and ignore the behavioral and organizational aspects of policy-making. However, adaptation studies must take into account the implications of these institutional and behavioral findings from the policy sciences in developing and proposing policy alternatives and recommendations for action which have any chance of being accepted and put into practice and to be successful once implemented. But this is not a simple matter as it requires abandoning many of the high-level functional assumptions and presuppositions about policy-making and knowledge use which currently color this work.

6. Conclusions

As Maarten Hajer has argued, the means by which ideas of any kind become 'enduring policy practices' is a process of discourse institutionalization, 'when the actual policy process is conducted according the ideas of a given discourse' (1993, 48). This has happened with SST in the forest and many other sectors where a growing number of strategic

documents employ some conception of natural and social systems linked by a functional logic.

Holling (2001), astutely in developing this framework, noted various examples of social and political events that fail to conform to the logic of complex adaptive systems including entrepreneurial innovation. But the central point remains: although sophisticated models and terminology have emerged in SST at a theoretical level, the central causal story of complexity and risk that has become institutionalized in the practice of adaptation research and assessment serves both to obfuscate important policy dynamics and undermine the potential for prompt and effective action. The latter requires a much more precise and accurate assessment of policy dynamics and discursive effects than such models currently possess (Dovers and Hezri 2010).

This failure on the part of adaptation studies to incorporate the findings of the policy sciences has serious consequences for effective action on climate change. In practice this SST-inspired discourse has adopted a functionalist and determinist logic on policy-making and knowledge utilization ('these problems must be addressed for system stability'), whose outcome has been a series of unrealistic or infeasible options, which, even if accepted by governments, are unlikely to be implemented successfully.

At best, SST-inspired frameworks reproduce a broken model of science-policy interaction in which, provided that they present a 'scientifically credible' consensus, specific actions are urged upon governments as immediately necessary. In such cases, barriers (e.g. lack of political will, centralized decision-making, availability of technology, legal limitations) are usually offered as explanations for the 'gap' between the current and expected output of decision-making, that is, something must be preventing policy-making from attaining its true equilibrium (Moser and Ekstrom 2010; Biesbroek et al. 2015;). The management recommendations of such science assessments are supposed to provide compelling reasons for policy innovation, but without reference to other existing policies and policy discourses which can and do contest them and render policy-making based upon them highly problematic.

At worst, these adaptation frameworks can serve in themselves as a form of blame avoidance for future policy failures. That is, the institutional practice of continually commissioning poorly informed assessments in itself can be viewed to be part of a politics of climate change policy-making in which the production of the outputs of assessments – the reports, strategies, vulnerability assessments, and so on – serve the agencies that fund them by appearing to react to a problem while offering little prospect of (expensive and controversial) change on the ground (Saward 1992).

Notes

1. Public ownership in Australia is 77% (Australia 2015); Canada (94%) (NRCan 2013); Finland (26%) (Ministry of Agriculture and Forestry 2006); Germany (34%); US (43%) (Alvarez 2007).
2. The work of the Stockholm Resilience Centre (http://www.stockholmresilience.org/) provides a contemporary example of a research program that combines many elements of these integrated systems approaches.
3. According to Seppälä, Buck, and Katila (2009) most forest policy, when taking into account climate change consideration, has been reactive in nature.
4. The full analysis of this study are in a manuscript under review.

5. It is the Landers, who are responsible for forests that have developed adaptation strategies that comply with the federal frameworks.

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