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# Beyond the black box: Forest sector vulnerability assessments and adaptation to climate change in North America

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## ABSTRACT

In the wake of the failures to date of well-publicized multilateral and multi-sectoral mitigation efforts to control greenhouse gases, attention is now increasingly focused on the effectiveness and capacity of national and sub-national level sectoral plans, including forestry, to usher in a new era of adaptation efforts. In Canada, the government of British Columbia spent several years developing its Future Forest Ecosystems Initiative as part of a larger climate change response strategy in the forest sector. Similarly, in the United States, wildfire related events have led to climate change inspired efforts by individual states (e.g., Alaska, California) and the US Forest Service has recently undertaken plans to incorporate climate change considerations in national forest planning beginning with the National Road Map for Responding to Climate Change. This paper highlights a number of shortcomings with both these national and sub-national strategies with respect to the relationships existing between governance, forestry and climate change. It proposes incorporating considerations of governance mechanisms directly into forest sector planning and the need to assess not only natural system level changes but also the extent to which new problems can be dealt with by 'old' or 'new' governance arrangements.

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## 1. Introduction

In the wake of the disappointing outcomes of multilateral and multi-sectoral climate change mitigation efforts such as the Kyoto Protocol and the Copenhagen Accord, attention is now

increasingly focused on the effectiveness and capacity of national and sub-national level sector plans to address adaptation related issues (Ottinger, 2010). On both sides of the Canada–US border forest sector climate change policy adaptation frameworks have proliferated as government

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agencies attempt to scope new ways to incorporate climate change vulnerabilities into daily decision-making. From these assessments, adaptation plans and frameworks at both the national and sub-national levels are being developed in order to facilitate and “mainstream” a new round of policies and programmes. According to [Brooks and Adger \(2004\)](#), “mainstreaming” refers to “the integration of adaptation objectives, strategies, policies, measures or operations such that they become part of the national and regional development policies, processes and budgets at all levels and stages” (p. 211).

There are three major uncertainties about the precise impacts of climate change on existing policy regimes in the US and Canada which are highlighted in many forest climate change assessments as driving government adaptation efforts. First, changes in growing conditions may threaten the ongoing efforts of forest managers to match tree species and subspecies to appropriate sites when replanting after harvest, with a significant real and potential loss of forest productivity ([Johnston et al., 2009](#)). Second, the prediction of hotter and drier conditions throughout much of western North America may pose additional challenges for forest managers. In Canada, for example, temperatures are expected to continue to increase and conditions become significantly drier for the southern edge of the boreal forest from northern Ontario, through Manitoba, Saskatchewan and into northern Alberta (and even BC and Alaska in some models). A warmer and dryer climate suggests an increase in the frequency, extent and severity of forest fires in these regions ([Wotton et al., 2010](#)) as well as changes in existing patterns of forest insects and diseases. Similarly, in the US, dry conditions led to catastrophic forest wildfires as early as 2003 in the southern Californian counties of San Bernardino, Riverside and San Diego ([Grulke et al., 2009](#)) and are expected to increase. Third, the network of protected forest areas that has been laboriously created to address biodiversity conservation goals (notably the efforts to combine the 12% minimum protection promoted after Rio with conservation biologists’ recommendations for the protection of a network of “representative ecosystems”) may not now be able to meet these goals. As a recent Ontario climate change assessment notes: “current protected areas may no longer contain the “best” representative examples of features, ecosystems and species. As species migrate and ecological boundaries change in response to climate change, ecological communities will change and some may be lost from within the fixed boundaries of protected areas” ([Government of Ontario, 2011](#); p. 10). Can American and Canadian forestry adaptation to climate change planning efforts develop effective and implementable strategies for forest sector adaptation in light of these major challenges?

This article presents two cases of forest adaptation frameworks developed in the US and Canada and highlights two key weaknesses in the way that these and other national and sub-national strategies have operationalized the relationships between governance, forestry and climate change policy-making. These are (1) a disjuncture between the desires of governments and affected stakeholders to mainstream climate change adaptation concerns with

the incomplete and misleading conception of governance presented in the climate change vulnerability and assessment literature, and (2) the role of “micro” level factors, such as policy capacity or on-the-ground implementation resources which affect both a government’s ability to plan and societal actors abilities to take part in those plans and planning efforts.

Existing forest sector adaptation planning frameworks generally seek to consider climate change vulnerabilities using macro-level systems-based vulnerability assessments currently in vogue amongst geographers and natural resource managers and, on this basis, to develop “mainstream” adaptation plans that can be integrated into public policy decision-making ([Burton, 2010](#); [Keskitalo, 2011](#)). When addressing the feasibility of proposed climate change policy solutions, the impact of the policy and governance systems is rarely considered. [Wellstead et al.’s \(2012\)](#) critique of the vulnerability assessment literature found that it is often informed by a latent structural-functional logic. While vulnerability assessment frameworks can provide a useful heuristic, the functionalist assumptions inherent in these approaches leave much to be desired in terms of understanding political phenomena, including activities such as public policy-making. For example, as the renowned Norwegian social and political theorist Jon [Elster \(1986\)](#) noted, functionalism is a “puzzling and controversial” mode of explanation in general because, unlike other scientific modes such as causal or intentional explanations (where the intended consequences occur earlier in time), early events are explained by another event later in time (p. 31). Thus, in a functional explanation, “we cite the actual consequences of the phenomenon in order to account for it” (p. 31). Feedbacks loops are the essential mechanism in functional reasoning because they provide “a causal connection from the consequences of one event of the kind we are trying to explain to another, later event of the same kind” (p. 32). However, in social and political situations, as Elster further argued, such explanations are “only applicable when a pattern of behaviour maintains itself through the consequences that benefit some group, which may or may not be the same group of people displaying the behaviour” (p. 32). Thus, most climate change vulnerability assessments simply assume that governance and policy activities will be performed in specific ways due to system-level prerequisites based on natural resource characteristics, ignoring the possibility of non-performance and the role played in it by meso and micro level institutional and governance-related variables. Following a discussion of the cases, the paper sets out these problems and suggests ways they can be addressed in future studies and planning processes.

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## 2. The characteristics and problems of existing forest sector vulnerability assessments: “black-boxing” governance and downplaying political factors

Canadian and American federal, provincial, and state governments have recently undertaken several well-publicized vulnerability assessments linked to climate change adaptation in

the forest sector (Spittlehouse and Stewart, 2003; Lemprière et al., 2008; Jantarasami et al., 2010). These assessments are often part of larger cross sector climate change strategies that were originally intended to address the mitigation of CO<sub>2</sub> emissions. For example, the Alberta provincial government released the 2008 Climate Change Strategy with a 200 megatonne emissions reduction target but only by 2050 (Government of Alberta, 2008). With such extended targets, the strategies also acknowledge the need for adaptation measures. In response, Alberta, a province-wide Climate Change Adaptation Framework was developed with the intention of being applied at the individual sector level (Government of Alberta, 2010).

In Canada's forest sector, the Canadian Council of Forest Ministers (CCFM) identified climate change adaptation as a priority in its five-year strategy *Vision for Canada's Forests: 2008 and Beyond* and began developing a national vulnerability assessment and strategy at that time (Canadian Council of Forest Ministers, 2011). Provincial governments, who have the major responsibility for on-the-ground forest planning, have also been active in this area. For example, as part of a larger climate change response strategy in the British Columbia forest sector, the province's Chief Forest initiated the *Future Forest Ecosystems Initiative* that spurred a reconsideration of policy direction.

Similarly, in the United States, wildfire related events have led to climate change adaptation inspired efforts by individual states (e.g., Alaska, California) and the US Forest Service (USFS) has recently undertaken plans to incorporate climate change consideration in National Forest planning beginning with the *National Road Map for Responding to Climate Change*.

The two case studies described below, namely the British Columbia *Future Forest Ecosystem Initiative* and the USFS's *National Roadmap for Responding to Climate Change*, and their corresponding regional strategies, namely the *Kamloops Future Forest Strategy* and the *Northwoods Climate Change Response Framework* illustrate how existing and future governance arrangements and their logics of policy change have been treated and the general tendency of such studies to “black box” institutional arrangements. The term “black box” is borrowed from science and engineering to describe a system or object, which can be viewed solely in terms of its input, output and transfer characteristics without any knowledge of its internal workings. The empty black box problem states that for most functional explanations there is no known mechanism and therefore explanations “are apparently baseless” (Pettit, 2000, 35). Since governance is what takes place inside the black box, these approaches limits the ability of government agencies to generate recommendations and prescriptions that can be successfully adopted and implemented. The traditional assumption of “policy automaticity”, in which outputs are an automatic response to inputs, is so prevalent in the forest sector that it has rendered the consideration of a more sophisticated policy logic unwarranted. However, the pressing nature of rapid changes associated with climate change adaptation requires new and more realistic policy analysis approaches, which give due weight to political and governance-related policy drivers.

## 2.1. Canada: the British Columbia future forest ecosystems initiative

In 2008, the Canadian Council of Forest Ministers (CCFM), a national “forum for the federal, provincial and territorial governments responsible for forests to work cooperatively to address major areas of common interest” called for a collaborative strategy on forests and climate change (CCFM, 2011). However, a national forest climate change adaptation framework has not been publicly released. Moreover, the provinces retain ownership and jurisdiction over 77% of Canada's forests (Haley and Nelson, 2007; Natural Resources Canada, 2011). This diverse ownership by the provinces has resulted in an uneven development of climate change strategies. Some provincial government agencies such as British Columbia's Ministry of Forests, Lands and Resource Operations, Ontario's Department of Natural Resources, and Quebec's Ministère des Ressources have dedicated resources to planning efforts with the intention of developing well-articulated climate change adaptation frameworks. Others, including the federal government, have lagged behind.

In recent decades, British Columbia's forests have experienced a number of significant wild fires (2003 and 2009) and a major Mountain Pine Beetle infestation affecting 14.5 million hectares between 1990 and 2008 (Government of British Columbia, 2010). Both were attributed to a changing climate and both have had profound impacts on the province's economy (Government of British Columbia, 2010). These two impacts also changed the accepted assumptions of provincial forest management (British Columbia Ministry of Forests and Range, 2006; Woods et al., 2010). The provincial government's concern and early action on this issue resulted in a well-documented planning process, and, hence, the choice of the Canadian case.

In early 2007, British Columbia's Chief Forester, an independent senior civil servant who advises the Ministry of Forests and Range on forest management decisions, ordered the creation of the *Future Forest Ecosystems Initiative* (FFEI). Its purpose was to begin a process of changing the existing forest management legislation, planning and on-the-ground guidelines to reflect climate change adaptation needs (BC Ministry of Forests and Range, 2008). The FFEI was a three-phase undertaking: (1) assessing the available knowledge about climate change impacts and adaptation; (2) developing a knowledge base including options and recommendations; and (3) implementing climate change adaptation recommendations into existing forest resource management policy and legislation (BC Ministry of Forests and Range, 2006).

During Phase II, the Ministry established the *Future Forest Ecosystems Scientific Council* (FFESC) (comprised of representatives from the Ministry and academia) to guide the allocation of \$5.5 million to support 25 research projects aligned with the objectives of the FFEI. The largest project in terms of funding and landscape was “Validating impacts, exploring vulnerabilities, and developing robust adaptive strategies under the Kamloops Future Forest Strategy” (Kamloops Future Forest Strategy II, 2012; British Columbia Ministry of Forests and Range, 2011).

The 2.7 million hectare Kamloops Future Forest Strategy (K2) case study is located within the Kamloops Timber Supply

Area (TSA) and is part of the Kamloops and Headwaters Forest Districts. K2 was initiated to create a vision of forest management for resilient conditions and a strategy to achieve those conditions within a Timber Supply Area (TSA). The K2 strategy included a framework to “identify issues and possible management actions to address plausible futures” and address three themes namely “planting different species and species mixes than those presently used to address a changing climate, targeting harvesting in vulnerable stand types, and rethinking retention strategies to take into account greater uncertainty that climate change highlights” (*Kamloops Future Forest Strategy*, 2011). The backbone of the K2 framework is a five model meta analysis. These complex models examine tree species responses to climate change using forest stand hydrology and its impacts on stand development and regeneration, model forest stand growth and ecosystem dynamics with a changing climate, and temporally analyze changes at the landscape level. However, analysis of the institutional components and governance aspects of these issues are missing.

At a FFESC Closing Conference and Workshop held in June 2012, a report, *Informing Adaptation of British Columbia's Forest and Range Management Framework to Anticipated Effects of Climate Change: A Synthesis of Research and Policy Recommendations* was prepared and presented to attendees as a starting point for future adaptation to climate change policy development. Unfortunately, when the issue of governance was raised it was treated as a system input as described in the critique above; “[s]upport is needed for a wide spectrum of learning opportunities, decision-making frameworks and governance mechanisms” (*British Columbia Ministry of Forests and Range*, 2012, p. 19). The prospect of changing policy instruments in a new policy framework was also raised. However, neither the type of instrument change nor other critical dimensions of governance discussed below were included in the report.

## 2.2. The United States: the US Forest Service's national roadmap for responding to climate change

The importance of federally owned land in the United States has resulted in a comprehensive national level climate change strategy led by the US Department of Agriculture (USDA). At the departmental level, one crucial goal of the USDA's 2010–2015 Strategic Plan was to “ensure our national forest and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water” (*USDA Forest Service*, 2011a). From this strategy, the USDA Forest Service responded to one of the Plan's objectives (#2.2) to lead efforts to mitigate and adapt to climate change in the forest sector.

In October 2008, the Forest Service introduced a *Strategic Framework for Responding to Climate Change*, that was followed by the “USFS National Road Map for Responding to Climate Change” and the USFS Global Change Research Strategy. From the Road Map, the USFS would “hold itself accountable for progress under this roadmap in four major dimensions: agency or organizational capacity; partnerships and conservation education; adaptation; and mitigation” (*USDA Forest Service*, 2010).

One key roadmap measure was a “Climate Change Scorecard” that called for the reporting of accomplishments and plans based on ten key questions along the above four dimensions and measured at different scales from the national forest level, by Regional/Station/Areas who were responsible for developing “Partnership Landscape Conservation Strategies”, down to the unit level. In conjunction with the scorecard, the USFS Unit office also took an active role in taking climate change into account during the Planning Rule Revision of the *National Forest Management Act* (NFMA). The NFMA requires every national forest or grassland managed by the USFS to develop and maintain a Land Management Plan. The Planning Rule Revision is the process for the development and revision of the plans (*USDA Forest Service*, 2011a). “The new planning rule” according to the Proposed Rule document, “must be responsive to the challenges of climate change” (*Department of Agriculture*, 2011, p. 8480). As part of the planning rule process, the USFS conducted 29 national and regional public information forums and received over 300,000 comments (*USDA Forest Service*, 2011a). Although internally developed within the USFS, the roadmap would be very much influenced by bottom-up considerations in an ongoing planning process.

Three USFS Climate Change Response Frameworks (CCRF) provide examples of a unit level climate change action where such bottom up governance and policy capacity considerations will be sought. These frameworks are the most developed adaptation plans in the USFS and follow the same logic as the K2 in British Columbia. They are the Central Appalachians CCRF, the Central Hardwoods CCRF, and the Northwoods CCRF. The Central Appalachians CCRF covers 27 million acres of eastern Ohio, eastern Maryland and West Virginia. The Central Hardwoods CCRF covers 42 million acres of southern Missouri, Illinois and Indiana. The Northwoods CCRF covers 26 million hectares of forested lands in northern Michigan, Minnesota, and Wisconsin (*USDA Forest Service*, 2011b). All three are collaborative efforts of the USFS, universities and the forest industry “to provide information on managing forests for climate change adaptation, enhanced carbon sequestration, and sustainable production of bio-energy and materials” (*US Forest Service*, 2011b). Its objectives include “provid[ing] a forum to effectively and efficiently share the experiences and lessons learned of managers and scientists [...], develop[ing] new user-friendly tools that can help public and private land managers to factor climate change considerations into decision making, and support[ing] efforts by public land managers, private landowners, and others to put these new tools to work on the ground ....” (*US Forest Service*, 2011a). Expert panels have been commissioned to undertake vulnerability assessments of natural forest communities.

## 3. Analysis: integrating governance concerns into forest management adaptation planning

The studies cited above in general focus almost exclusively on the resource base, however. In so doing they tend to ignore the governance challenges which forest policy-makers and managers face in addressing these issues. That is, adaptation



**Table 1 – A multi-dimensional policy and planning framework for climate change assessments and adaptation plans.**

Level of analysis	Key element/ actor	Policy and planning-relevant aspects	Current treatment in contemporary North American vulnerability assessment and adaptation plans
Systemic (MACRO)	Environment	Resources/constraints/feedback	Virtually exclusive focus
Structural considerations (MESO)	Government	Governance: state–societal relations	Usually assumed to be unproblematic
Organizational/human agency/ behavioural (MICRO)	Individual and organization al actors	Behaviour/choice (policy capacity, implementation of on-the-ground)	Assumed to automatically flow from system-level functional pre-requisites through “black box”

Source: Wellstead et al. (2012).

planning involves governments in a complex process of interaction with a variety of stakeholder organizations and interests affected by such plans. How these inter-relationships are managed or governed constitutes a major governance challenge which assessments and plans often ignore or downplay. Policy-making in many assessments and studies is simply taken for granted or “black-boxed”; that is, with the nuances of complex policy-making processes within government assumed to be straightforward and unproblematic.

The second feature that these studies ignore is the role of “micro” level factors, for example, policy capacity or on-the-ground implementation resources which affect both a government’s ability to plan and societal actors’ abilities to take part in those plans and planning efforts. Studies of the development of adaptation plans, for example, pay little attention to how new climate change oriented policies and programmes will be or have been formulated, implemented, and evaluated by agencies that have suffered decades of cutbacks and loss of capacity. And studies of the capacities of societal actors such as interest groups, NGOs and business associations are even rarer.

These actual and missing elements of the analyses are set out below (see Table 1).

To capture the full range of governance options and to determine whether policy designs are actually or potentially taking advantage of them, it is necessary for management plans to focus more carefully upon the neglected meso and micro levels in Table 1. Much can be learned by forest and climate change planners and planning activity from the existing policy and governance literatures on these subjects.

Each of these affected dimensions of forest and land use cited above, for example, has a significant governance component. With respect to the first, given that existing calculations of allowable cuts are based on estimates of the productivity of plantings and existing forests far into the future, such changes threaten even the narrowly defined policy goal of “forest sustainability” as the ability to produce a constant or growing volume of timber in perpetuity (British Columbia Ministry of Forests and Range, 2007). This has significant impacts not just on the forest base, but also on the existing disposition of harvests and location of processing facilities and forest-reliant communities, among others, which easily translate into demands for government action both in restoring the resource base but also in subsidizing or otherwise easing any necessary transitions or movements in forestry activities, from gas prices for trucking to labour market adjustments and transitional efforts.

As for the second, forest agencies will need to expend significant extra resources fighting wildfires and altered pest and insect infestations and these efforts will require adjustments in existing government and departmental budgets and human resource allocations. In the end, climate change may force a strategic change on forest managers such as allowing many more fires to burn or rapidly harvesting infested trees which will have consequences both for forest composition and extent as well as for estimates and actions related to carbon sequestration efforts (McKenzie et al., 2011) and, moreover, will affect local communities and industries both in the forest sector and others such as tourism and recreation. This has already been seen where the dynamics of forest pest infestations have been changed by warmer winters or drier summers as the mountain pine beetle outbreak in British Columbia’s interior has shown. Again, while these new conditions are predicted in many climate change scenarios, their precise timing and extent remain highly uncertain as does their impact on budgets, communities and the electoral fortunes of governments in affected areas, among other significant governance related activities and outcomes.

Finally, the bitter legacy of the forestry–environmental battles to create the existing system of protected areas ensures that adding new ones or even changing the boundaries of current protected areas will pose a significant challenge to forest policy-making and policymakers. With conflicting problem definitions and the sense of an endlessly moving target, the protected area issue has the potential to reopen a governance problem that many thought had been largely resolved. As in the past, it is very likely such efforts will result in high profile public engagement processes and necessitate laboriously constructed agreements between industry, government and parks and wilderness advocates, among others.

The mobilization of successful adaptive policies in the forest sector will involve greater horizontal coordination between government departments and societal groups. Such an approach has been attempted across resource and environmental policy sectors, including forests, for some time. But better horizontal coordination, in turn, requires capacity, competency, and commitment on the part of those providing critical policy advice (Peters, 1998; McConnell, 2010). Most existing forest climate change adaptation plans ignore these policy and governance-related issues however. As a close reading of key recent planning documents shows, the North American forestry sector climate policy literature remains overwhelmingly focussed on the biophysical impacts of climate change, and coordination problems that have so far

resisted solution are relegated to “black-box” modelling exercises which propose “necessary” management responses to rectify the situation (see Fussel and Klein, 2006), without actually addressing the feasibility or practicalities of adopting and implementing such responses.

While climate change issues affecting the forest sector are relatively easy to describe in biophysical terms, however, they are often quite novel and their impacts and causes are surrounded by a significant degree of uncertainty and complexity; making the design of appropriate policy responses highly problematic. In existing North American plans governance, namely policy and legislative changes within adaptation models, is treated either as a barrier to the changing forest management outcomes or as an input that needs to be changed to realize an optimal management outcome rather than an independent variable itself responsible for the attainment of policy success in this area. Existing North American forest sector adaptation plans at both the national and sub-national level remain heavily system-level focused and operate at a high “meta” level of generality with a distinct “black-box” orientation towards governance variables. The examples of current forest planning efforts in the U.S. and Canada and how they address the institutional level of policy-making set out above reveal these weaknesses. The British Columbia case study of K2, for example, is a classic example of an overemphasis of environmental systematic features (modelling) and black-box assumptions about organizational and structural considerations while the U.S. case is only slightly more encompassing.

#### 4. Conclusion

Institutional arrangements and organizational routines in the forest sector have never been entirely unproblematic. However, it is also true that the traditional forest policy regime up to the late twentieth century was an example of what Simon (1973) referred to as mix of relatively well-structured and linear problems. As such, forest planning agencies and departments were immersed in a relatively stable and long-standing forest management paradigm that rendered some of their activities as more or less “routine” and “automatic”. Forest policy regimes were associated with timber harvesting and conservation administered by hierarchically organized administrative agencies. These agencies were involved in such tasks as managing public forest lands to ensure a constant flow of wood fibre to the forest industry, and attempting to manage a small number of problems such as those involved in designing protected area and biodiversity conservation policies in the face of opposition from environmentalists and others to continued high levels of resource exploitation. In such well-structured issue areas (Dunn, 2004) agencies require little independent judgement or policy capacity in order to provide sound policy alternatives and outcomes. Forest government agencies in both countries have been resistant to internal change (Kaufman, 1960; Sabatier et al., 1995; Thomas, 2003). As Jantarasami et al. (2010) noted of the US Forest Service (USFS): “the slow adoption of climate change adaptation at the individual unit level (...) is not surprising given that the National Park Service (NPS) and USFS

have long operated through a traditional system of hierarchical authority, well-defined job descriptions, and standard operating procedures.” The routinized nature of many interactions and activities between and among forest sector actors over most of the twentieth century in the development and implementation of “sustainable yield management” is unmistakable and contributed to the idea of “policy automaticity” or the more or less automatic translation of system-level prerequisites into policy action.

This paradigm of policy automaticity longer is not valid with more difficult and novel issues such as climate change adaptation where existing issue networks and policy community boundaries are shifting (Skogstad, 2008) and where a growing number of diverse and conflicting policy actors no longer agree about problem definitions and potential solutions (Lazarus, 2009; Levin et al., 2009). Forest sector adaptation to climate change in this sense is a fully-fledged “wicked” problem (Rittel and Webber, 1973; Nie, 2003). Wicked problems can be defined when the problem is not understood until after the formulation of a solution. They have no stopping rule, there is no right or wrong solution, they are novel and unique and they have no given alternative solution (Conklin, 2005).

The crosscutting nature of climate change issues, for example, has blurred the identity of forest policy, which has moved from an almost exclusive focus on agro-industrial resource extraction and harvesting to the pursuit of a more complex set of policy goals arising from issues such as carbon storage, biodiversity conservation, energy policy (such as bio-fuels from wood waste) and many others. This development is reflected in the many changes made to the organizational functions of government agencies responsible for forest policy in recent years, which not only took on a larger environmental, or sustainable forest management (SFM) orientation in the last quarter of the twentieth century but has expanded this role greatly in response to a number of issues related to globalization, such as consumer and supply-chain certification and, especially, climate change mitigation and, now, climate change related adaptation.

The blurred boundaries of forest policy are both a cause and a consequence of a struggle over problem framing of the kind described in Hoppe (2010). While the assessment frameworks persist with their assumption that there is general agreement on both policy goals and the best means to achieve them (i.e. the problem as framed by the professional forest science community), both the goals and the means have become contested, creating the classic unstructured problem referred to above. The problem, therefore, may remain unstructured for a considerable time as the advocates of competing frames struggle to impose their view of the world or it may be partially structured in various ways through political negotiation and agreement. Nothing, however, will happen as an automatic systemic response to political “inputs.” Hoppe (2010: 145–166) describes a series of governance strategies designed to produce agreement and the early case study evidence of “push back” against adaptation policies clearly suggests the need to take these strategies seriously as political projects (Wellstead et al., 2012).

Most likely, conflict over the broader goals of adaptation policy, especially over the relative importance of mitigation and adaptation and over the appropriate time horizons, will

remain unsettled for a considerable time. Immediate progress is likely to be made in agreement over policy instruments, requiring a new emphasis on policy design in adaptation frameworks and strategies through the governance strategy Hoppe calls “negotiation and search” (2010: 122): what kinds of designs are likely to emerge in current circumstances? A black-box macro-level treatment of institutional variables in existing forest sector adaptation studies cannot provide realistic policy answers. Due to their neglect of meso and micro level governance variables, most existing models and frameworks may be helpful as heuristics in understanding complex ecosystem interactions but their policy relevance and ability to predict or inform policy-making on-the-ground is limited. Without better incorporation of meso-level policy-related variables such as institutional and governance arrangements or the role of expertise and advice at the micro-level, the strict adherence to their prescriptions is likely to result in policy failure because many proposed solutions will be infeasible or otherwise unattainable for a variety of programme-based, institutional, and political reasons.

Forest industry and forest dependent communities are being challenged to adapt to these new conditions, often by being encouraged to respond favourably to opportunities provided by the new climate change policy agenda. For example, mitigation and adaptation are closely linked when the industry is urged to replace existing trees species with fast growing hardwood species that can sequester carbon or provide biomass for energy (Park and Wilson, 2007). The interest in developing “second generation” biofuels from wood waste is also an important related development.

At this point, however, new policies addressing climate change adaptation within the forest sector becomes inextricably linked to broader governance issues since these policy assessments involve multiple actors in complex relationships operating across several traditionally independent policy fields. Whether existing agencies and actors have the capacity to move beyond their old routines and produce and implement policy designs capable of meeting the new challenges, for example, is a critical question of contemporary forest policy and one that existing analyses focussed only on macro-systemic variables and aspects of adaptation and vulnerability challenges have hitherto ignored. Incorporating both micro and meso-level governance dimensions into these assessments is a necessary step for them to move forward and inform successful adaptation efforts.

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