



Research, part of a Special Feature on [The Governance of Adaptation](#)

Water Governance in Chile and Canada: a Comparison of Adaptive Characteristics

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ABSTRACT. We compare the structures and adaptive capacities of water governance regimes that respond to water scarcity or drought in the South Saskatchewan River Basin (SSRB) of western Canada and the Elqui River Basin (EB) in Chile. Both regions anticipate climate change that will result in more extreme weather events including increasing droughts. The SSRB and the EB represent two large, regional, dryland water basins with significant irrigated agricultural production but with significantly different governance structures. The Canadian governance situation is characterized as decentralized multilevel governance with assigned water licenses; the Chilean is characterized as centralized governance with privatized water rights. Both countries have action at all levels in relation to water scarcity or drought. This structural comparison is based on studies carried out in each region assessing the adaptive capacity of each region to climate variability in the respective communities and applicable governance institutions through semistructured qualitative interviews. Based on this comparison, conclusions are drawn on the adaptive capacity of the respective water governance regimes based on four dimensions of adaptive governance that include: responsiveness, learning, capacity, including information, leadership, and equity. The result of the assessment allows discussion of the significant differences in terms of ability of distinct governance structures to foster adaptive capacity in the rural sector, highlights the need for a better understanding of the relationship of adaptive governance and good governance, and the need for more conceptual work on the interconnections of the dimensions of adaptive governance.

Key Words: *adaptive governance; climate change; extreme weather; water governance*

INTRODUCTION

Although many groups in society have a history of accommodation to climate conditions, climate change challenges this traditional coping range. Contrary to the perception that climate change will have a uniform effect, resulting from a warming of the whole planet through a linear, gradual process, there is the possibility of a significant readjustment of regional conditions (IPCC 2007). Many scientists believe there is a potential for a “tipping point” or threshold beyond which global warming could potentially be very dangerous, bringing sudden and abrupt changes to natural and social systems and their equilibriums (Henson 2006, Brown 2007, Lovelock 2007, Pearce 2007) and creating conditions of extreme risk for millions of people, large financial losses, and severe societal stress. One of the most significant sources of risk will be an increasing occurrence and intensity of extreme climate events, such as more intensive and longer droughts, floods, and heat waves (Henson 2006, Brown 2007, IPCC 2007). Moreover, climate change could either exacerbate the already negative impacts of nonclimate stressors, such as the absence of proper health services, or it could contribute to increasing people’s sensitivity to already existing risky economic or political conditions. In this vein, the fact that most of the world population lives in poverty is an important indicator of how vulnerable is most of the world population to climate change (IPCC 2007, Christoplos et al. 2009, Timmons Roberts 2009).

The two study regions, the South Saskatchewan River Basin (SSRB) of western Canada and the Elqui River Basin (EB) in northern Chile, represent two large, regional, dryland water basins with irrigated agricultural production and similar climate conditions. A water deficit is a characteristic of the SSRB, this is Canada’s largest dryland watershed, with the high winds accelerating evaporation. The expected impacts of climate change on the basin involve drier conditions, more extreme weather events, such as droughts and their related impacts on the quantity and quality of their water resources, as well as increasing climatic uncertainty (Sauchyn et al. 2002, Sauchyn and Kulshreshtha 2008, Lapp et al. 2009). The ERB’s average precipitation is 100 mm per year, although it may vary according to the El Niño Southern Oscillation Regional records that show a decrease in precipitation over the past century; although in the last 25 years, the precipitation trend has levelled off, and even shows a slight recovery (Fiebig-Wittmaack et al. 2008). Still, this is among the most pronounced decreases in all of Chile, and it affects both human and natural systems (Cepeda 2008). Future climate change scenarios show a trend toward increased maximum and minimum temperatures, especially in winter, an increasing number of hot days, and an annual precipitation that remains close or a little bit lower than the annual average (Fiebig-Wittmaack 2009). Both regions are heavily engaged in agriculture, an activity that imposes increasing pressure upon scarce water resources. In both basins rural communities are

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sensitive to a variety of climate variability-related events, including late and early frosts, hail, and heavy precipitation. However, the predominant climate-related issue in both basins is drought, which is expected to increase in intensity in the future. Both study regions have experienced increasing social differentiation among producers with a small group having large tracks of land and access to capital, and a larger number surviving on small farms (Diaz et al. 2009, Salas et al. 2012).

The institution of governance is a key determinant of people's vulnerability to climate change and variability, as well as in relation to other stressors (IPCC 2001). Its role in shaping decision-making processes and the development and implementation of resource distribution, infrastructure, and technological development policies and programs plays a fundamental role in defining people's level of exposure, degree of sensitivity, and adaptive capacity to climate. In these terms, ensuring that the formal institutions of governance have the capacity to both provide the conditions and mechanisms necessary to reduce people's vulnerabilities and adapt to changes in the environment, a capacity we define in the paper as adaptive governance, is crucial for reducing vulnerability and increasing resilience. There is an increasing literature in the area of governance and the environment that has listed different types of conceptual institutional design principles, or indicators, of what is considered to be adaptive governance (Gunderson and Holling 2002, Folke et al. 2005, Olsson et al. 2006, Huitema et al. 2009, Gupta et al. 2010, Huntjens et al. 2012).

THE DIMENSIONS OF ADAPTIVE GOVERNANCE

According to the Intergovernmental Panel on Climate Change (IPCC), there are several determinants that contribute to the ability of a social system to adapt, including economic wealth, technology, information and skills, infrastructure, institutions, and equity (IPCC 2001). These determinants, also defined as forms of capital (DFID 2000), could be used in different proportions and combinations to improve the social system to reduce its risk. In relation to institutions the IPCC argues that nations with "well developed institutional systems are considered to have greater adaptive capacity" and that developed countries have a better "institutional capacity to help deal with risks associated to with future climate change" (2001:896 and 897).

An institution is a stable, collective pattern of dealing with a basic social function (Lauer et al. 2006). Formal institutions are represented by government ministries, water management organizations, laws, policies that define the roles and procedures for people to organize themselves (Buttel 1997), whereas informal institutions embody the socially shared rules or norms that impact behavior (Helmke and Levitsky 2003). Governance involves formal and informal institutions and it entails the interactions among processes, rules, and traditions that determine how people in societies make decisions and share power, articulate their interests, exercise responsibility

and mediate their differences, and ensure accountability (Lebel et al. 2006, Raik and Decker 2007, Armitage et al. 2009, Cundhill and Fabricius 2010, Kiparsky et al. 2012). It consists of laws, regulations, as well as governmental policies and actions, domestic activities, and networks of influence, including international market forces, the private sector, and civil society (Demetopoulou et al. 2010).

Governance assumes distinct structural forms in different contexts. It could be organized as a federal structure, as is the case of Canada, or centralized, as in the case of Chile. It could have different levels of integration and participation of civil society into the decision-making processes, and it could range from highly authoritarian to fully democratic regimes. This diversity of governance structures is due to a variety of historical circumstances and it includes worldviews, those perspectives that shape the organizational frame, processes, and direction of governance. Thus, governance could have different purposes and organizational settings under the influence of a socialist or a neoliberal discourse. Diversity also extends into the different sectors of government. Thus, water governance, the focus of this paper, refers to the range of political, social, economic, and administrative systems that develop, manage, and distribute water resources (Rogers and Hall 2003). Water governance involves public and civil society organizations and comprises norms, programs, regulations, and laws, relevant to the management of water resources (Hall 2005). The description of the context or form of water governance will be termed as "structure" for the purposes of this paper.

To deal with the increasing complexity of global change scholars have argued for a new style of governance that involves shifts in focus from government rule-based systems and fixed organizations to a view of institutions as dynamic, flexible, pluralistic, and adaptive to cope with present and future uncertain climatic conditions and the limits of predictability (Berkes and Folke 1998, Carpenter and Gunderson 2001). Thus, more flexible, participatory, experimental, collaborative, and learning-based designs and approaches to policy making and governance could increase the adaptive capacity of communities and improve sustainability of natural resources (Lee and Lawrence 1986, Walters 1986, Walters and Holling 1990, Tompkins and Adger 2004, Kallis et al. 2006, Pahl-Wostl 2007*a,b*, 2010). This description is an ideal state of governance, able to effectively respond to complex environmental issues such as climate change, as well as the practices and characteristics of policy making and governance to achieve resilience, and it is referred to as adaptive governance, or adaptive management by some.

Key foundational principles of adaptive governance include the incorporation of an understanding of ecosystem dynamics into resource management and planning, the utilization of an ecological knowledge system able to interpret and respond to ecosystem feedback, and the monitoring of external drivers to

Table 1. Dimensions of adaptive governance.

	Institutional Design Principle of Adaptive Governance	Related Principles/ Subprinciples	Explanation	Literature
1	Responsiveness		The ability of governance networks, organizations, and actors to respond appropriately and in a timely manner to climate variability, hazards, and extreme events in a manner that accounts for ecosystem dynamics	Dietz et al. 2003, Kjaer 2004, Hatfield-Dodds et al. 2007
2	Variety of problem frames	Robust and Flexible Process	Institutions and policy processes that continue to work satisfactorily when confronted with social and physical challenges but which at the same time are capable of changing	Mollenkamp and Kastens 2009, Huntjens et al. 2012
		Multilevel – redundancy	Openness to multiple frames of reference, opinions, and problem definitions offering a diversity of sometimes competing solutions and options to assess a problem as well as resolve conflict	Gupta et al. 2010
		Polycentric governance	A variety of problem frames inherently involves the participation of a variety of different actors, levels of government, and sectors in the governance process and collective choice arrangements, without redundant overlapping costly systems	Huntjens et al. 2012
		Sectoral integration	Different centers of management and control should exist, as opposed to hierarchical systems	Ostrom 2010
3	Learning and institutional memory		Adaptation requires an integrated sectoral response so institutional arrangements that are similar or related can be adjusted to one another	Mollencamp and Kastens 2009
			Past experiences must be remembered, learned from, and routines improved.	Pretty and Ward 2001, Dietz et al. 2003, Pretty 2003, Olsson et al. 2004, Armitage 2005, Gupta et al. 2010, Huntjens et al. 2012
		Participation	Participation by nonstate actors	Folke et al. 2005
4	Trust	Collective choice arrangements	To enhance participation of those involved in making decisions about the system in how to adapt	Huntjens et al. 2012
		Monitor and evaluate	Institutional evaluation processes must monitor and evaluate policy experiences	Huntjens et al. 2012
			Institutional patterns must exist to promote mutual respect and trust such that participants continue involvement in the process of governance	
5	Capacity Building	Open to uncertainty/ Open to experimentation	Policy experiments allow feedback loops so policy can be changed quickly in response to changed conditions	Mollenkamp and Karstens 2009
		Constructive conflict resolution	Timely response to problems, careful sequencing, transparency	Huntjens et al. 2012
		Information Leadership Resources	The informational, human, and social capital must exist within the governance regime necessary to respond appropriately to climate variability, hazards, and extreme events.	Olsson et al. 2004, Gupta et al. 2010
6	Equity		Leadership must exist to act as a catalyst to change; Appropriate resources (financial, political, human) must be available for this change	
		Information	Rigorous, up to date information, sufficient and reliable	Mollenkamp and Kastens 2009
7	Political Support	Legitimate Accountable Fair	The governance regime must be perceived as legitimate and accountable, as well as fair in its process and impact such that there is an equal and fair (re)distribution of risks, benefits, and costs	Gupta et al. 2010, Ostrom 2011, Huntjens et al. 2012
8	Clearly defined boundaries		Responding to climate change is a long-term policy challenge that requires solid political support for plans longer than election cycles	Mollenkamp and Kastens 2009
			Clarity over who has water rights, who has responsibility, capacities, access to resources, and information in times of climate events	Huntjens et al. 2012

deal with uncertainty and surprise (Berkes and Folke 1998). Table 1 outlines some of the key characteristics, or institutional design principles, that governance regimes should have to be

adaptive, or to practice “adaptive governance.” Note that the terminology of “institutional design principles” and the content of these principles are by no means consistent. Some

authors term them “evaluative criteria” (Ostrom 2011) or even “elements” of adaptive institutions (Mollenkamp and Kastens 2009). The number of dimensions of adaptive capacity tends to vary depending on the author, ranging from a few characteristics, such as the six dimensions listed in the work of Gupta et al. (2010) to a long suite of attributes, as those identified by Cook et al. (2011). Fröhlich and Knieling (2013) in their discussion of climate change governance offer another set of attributes that should also be considered in a discussion of adaptive governance.

There are many key institutional design principles, as well overlaps and connections between design institutional principles. The discussion in some cases is generic and it applies to institutions in general (Gunderson and Holling 2002, Olsson et al. 2006, Gupta et al. 2010) and in other cases to specific institutional regimes, such as the case of water governance (Huitema et al. 2009, Mollenkamp and Kasten 2009, Young 2010, Cook et al. 2011, Hill 2012, Huntjens et al. 2012). The literature contains a diversity of permutations, groupings, and emphasis. These have been grouped for the purposes of this paper into the following categories: responsiveness, variety of problem frames, learning and institutional memory, trust, capacity building, equity, political support, and clearly defined boundaries.

One of the most important principles is that of responsiveness of governance institutions to both the natural and social environment in a flexible, timely manner. However, other principles including the participation of many stakeholders in policy decisions (Williams and Johnson 1995, Nelson et al. 2008, Williams 2011), the element of trust, the ability to generate resources, financial, human, political, etc. (Gupta et al. 2010), and last, political support for adaptations (Huntjens et al. 2012) are required.

Adaptive governance should be understood not only in terms of managing complex environmental processes but also in terms of its capacity to reduce risks and increase opportunities of social groups exposed to those complex environmental processes. In other words, adaptive governance seeks to establish a fit between institutional and natural conditions to reduce the vulnerability of social groups. In these terms and in relation to water, adaptive governance is sited as creating a new generation of governance institutions for resolving collective action problems that occur between different types of resource users and different agencies tasked with resolving these conflicts (Scholz and Stiftel 2005).

METHODOLOGY

The data used in this paper were generated in the context of two studies. The first was a multi-interdisciplinary study of institutional adaptation to climate change in Chile and Canada (Diaz et al. 2009; for information about the project see www.parc.ca/mcri). The study focused on the current social and physical vulnerabilities of rural communities to climate and

water scarcities in the Canadian SSRB and the EB in northern Chile. The second, “Data in Canada,” was updated in the context of a multi-interdisciplinary study of drought impacts on rural communities carried out in the SSRB region in the province of Saskatchewan, Canada (Diaz and Warren 2012, Warren and Diaz 2012; for information about the project see <http://www.parc.ca/vacea/index.php/rcad>).

As part of the two studies we carried out several rural community vulnerability assessments. In this context, we asked the community residents to identify governance issues impacting the vulnerability of the communities and local livelihoods. They expressed concerns about the complexity of water governance, limited responses to their problems, and limited information about weather, climate, and climate change (Diaz et al. 2009, Reyes 2009, Warren and Diaz 2012). Around these issues we identified some relevant institutional design principles that were integrated into the governance assessment, including responsiveness (knowing who to contact and receiving action and answers), capacity (information and leadership), learning (having experienced previous extreme events), and equity (communities without water).

Information for the governance assessment was obtained from multiple sources, including public documents, focus group sessions, and in-depth semistructured qualitative interviews with representatives of water users, associations, watershed and environmental groups, community representatives, and all orders of government involved in water governance. Information about a wide array of organizational and procedural issues was gathered, including sources of climate information and data, past responses to situations of water stress, and long-term planning in relation to future climate and water stress. Reports were prepared for the two case studies, including a report on the Chilean governance assessment carried out in the first study of Canada and Chile (Diaz et al. 2009, Reyes 2009, Diaz and Warren 2012). The two study areas were chosen in Canada and Chile because of their significant similarities, although there are important differences with respect to governance structure between the two regions. However, significant differences in respect of governance structure exist between the two regions.

Water governance structures in Chile and Canada

Differences exist with respect to the organization and processes of governance institutions. Canada has adopted a federal system, whereby the federal and provincial governments assume responsibilities in different areas and in different degrees. Water rights, the prerogative of provincial governments in Canada, are allocated predominately based on “first in time first in right” rules. In Alberta, one of the provinces in the area covered by the SSRB, there is the ability to transfer interests in water under certain circumstances and in certain situations, however, an active water market is not

in existence. Although some parts of the study area are fully allocated and have experienced shortages in allocated water interests, this is a relatively rare occurrence. In the event of conflicts or disputes between water rights holders the government can take several measures to attempt to resolve the matter prior to leaving the parties to sort out their interests in a court of law. The Canadian governance situation is characterized as decentralized, multilevel governance with assigned water licenses (Hurlbert 2006, Bakker 2007).

Chile, on the other hand, has a central government, whereby functions and responsibilities are concentrated in central institutions that organize their work based on provincial agencies. In Chile a water code established a market for water rights, in which water rights are treated as any commodity, so they can be sold, rented, and transferred to other people. The government has a very limited role in administering water transactions and water conflicts because they are defined as issues to be resolved between private individuals. Given that in some areas water resources are fully allocated, many local communities, small, medium, or poor farmers may be without water rights and without the means to purchase them (Bauer 1998, Reyes 2009).

These differences, however, are reduced by the fact that both governments have embraced a neo-liberal approach to governance. A neo-liberal approach to governance is a strategy pursued by governments involving minimal government intervention in business, reduced public expenditures, and favoring free trade over social welfare spending. Chile has been more radical in its commitment to neo-liberalism, with its own particular impacts on natural resources such as water (Hojman et al. 1990). Canada, on the other hand, has redefined and shaped many of its economic programs and policies according to the fundamentals of liberalism but has maintained many of its social programs and a more active intervention of the state on social and economic issues. In these terms, in both countries the market and the private sector have taken a central role in economic development. Meanwhile, the government has invested its energies and efforts in establish a proper normative and institutional framework for the development of a liberal economy.

RESULTS

Comparison of adaptive capacity of governance in Chile and Canada

Responsiveness

Because both study regions are sensitive to drought, and drought is expected to become more prolonged and frequent, the ability of governance networks, organizations, and actors to respond appropriately and in a timely manner to droughts is essential. However, our evaluation of the governance institutions shows that limited institutional coordination and integration, a result of management rigidity, are challenges

limiting the responsiveness of water governance in both Canada and Chile, especially at the local level.

The centralized decision making of the Chilean government limits the activities of regional water agencies and local governments, which have very limited discretionary power to change water policies such that centralization and lack of institutional flexibility are recurrent complaints among regional agencies associated with water (Reyes 2009). At the regional and national level, multiagency coordination and planning is reactive rather than proactive (Salas et al. 2009). Local governments are first responders to natural disasters, but they lack the administrative and technical capacity to respond to water contamination or other management issues, limiting their capacity to help local people. In a drought context, for example, their activities are mostly limited to trucking in water to areas that may experience water shortages. Local governments also could pass environmental bylaws, but apparently lack the technical capacity to develop and implement them (Reyes 2009).

In Canada, a multitude of water organizations exists at the federal, provincial, and municipal level, making interagency coordination an issue. Complexity creates confusion even among government officials themselves, let alone stakeholders and the general public. Communities and local producers are often frustrated by the need to deal with a large number of agencies and they are often unsure which agencies are responsible for various aspects of water policy. Thus, there is an urgent need to establish clear roles and coordinate the activities of the multitude of agencies that are part of the water governance landscape, avoiding an increasing balkanization of water management (Bakker and Cook 2011). This is exacerbated by the rigidity of “first in time/first in right” water licenses. This is the case of Alberta, one of the two provinces that are part of the SSRB, where the development of further irrigation systems, agri-industry, and the provision to new rural residents, including some municipalities, has been constrained by this system.

Thus, in both cases there is also the need to strengthen the linkages among different levels of public organizations, and among organizations at the same level, to avoid the problems of institutional silos, i.e., uncommunicative, noninteractive organizations and practices (Fischer 2000). These linkages could contribute to the flow of information, resources, and knowledge in multisectorial and multilevel governance processes, creating the conditions for learning and adaptiveness, and facilitating the responsiveness of governance to climate extreme conditions.

The issue of responsiveness becomes more relevant in a future context in which both countries will increasingly face water shortages as a result of climate change with an amplification of potential conflicts among current water rights holders. Neither country has well-established institutions to respond to

these conflicts at the present moment. Chile will predominately rely on the court system and legal action; in Canada (Saskatchewan and Alberta) civil society and water bureaucrats will be relied on. Both of these processes take considerable time and resources and do not allow for an effective, efficient resolution of conflict, thereby increasing vulnerability of some rural actors and leading to further reductions in their adaptive capacity (Rojas et al. 2008). Although the bureaucratic system is generally faster to respond than court actions, and potential appeals, both systems are in need of improved access to justice.

In both countries, there is a continuous and increasing scientific knowledge about the long-term impacts of climate change, yet governments rarely set binding legislation and policy with a planning time frame further than a few years. Large investments required to adapt to future harsher climate conditions are costly and hard to implement for politicians interested in re-election in a few years especially in difficult economic times. As a result current governance relies mostly on reactive, crisis-management approaches. These time frame limitations make it very difficult for effective government response. The disparities between science and policy development speak also of a lack of integration between these two realms, an issue that is highly problematic if we assume the need for a continuous production of knowledge about processes characterized by uncertainty.

Responsiveness, however, has not been absent from the recent history of water governance in both countries. Historical research has demonstrated that a significant effort was made by the governments of both countries to reduce the negative impacts of climate after the severe droughts of the 1920s and 1930s. Investments in water conservation infrastructure and irrigation, supported by the creation of institutional conditions (agencies and legal framework) contributed to the development of an adaptive capacity that contributed to the expansion of agriculture in both basins (Marchildon 2009). This capacity to provide institutional response to the vulnerability of the rural populations has been reduced in the last three decades, mostly as the result of an increasing neo-liberalization of the state and its policies.

Learning

Community members interviewed expressed frustration with government over water decisions, information, timely responses, and assistance in responding to events of drought and climate extremes. This frustration existed even though the study regions had a history of experiencing water shortages and drought. Logically, the issue of learning from past events and responding to future events arose.

Adaptive policies, to be effective, must be supported by a public institutional system that is reflexive: able to reflect about and to learn constantly from those other systems with which it interacts and from its own experiences. This is a

necessary condition for the development of policies “that can anticipate and respond to an array of conditions that lie ahead, and can navigate towards successful outcomes when surprised by the unforeseen” (Venema and Drexhage 2009:1). Rigid policies that are unable to cope efficiently with the uncertainties and dynamics of new climate conditions are obviously a serious obstacle to be overcome in the two countries. Institutional learning increases the capacity of public organizations to deal with a multiplicity of challenges, and change trajectories and practices. Implicit in institutional learning is preparedness to experiment, preventing rigid persistence and purposefulness of practice (Goodin 1996).

The development of a learning institutional system must comply with two necessary and coupled institutional conditions. First, there must be a capacity to collect and process information about key components of systems, in our case, water quality and availability, as well as climate events and their impacts, in which policies and programs are being applied, so there is knowledge of the pace of change and the degree of policy success in coping with change. The second institutional condition is the vertical and horizontal coordination and integration of institutions, which allows for the sharing of information. With these preconditions, social learning can occur. Integrated watershed management is one tool used to facilitate vertical and horizontal coordination and stimulate learning.

Integrated watershed management has emerged in both countries in accordance with the idea of adopting good practices in water governance and allowing the local community to holistically manage water (Rogers and Hall 2003). The integration of local stakeholders in government decision-making processes could improve the capacity of public organizations to learn, to obtain information, and to disseminate it, as well as to monitor and evaluate policies' impacts on the local climate and social conditions. Canada has been significantly more advanced than Chile in this regard. There are many civil society organizations, i.e., watershed advisory councils or committees in Canada and the pilot project “Water Dialogues” in Chile, participating in decisions relating to specific watersheds. There are still considerable institutional barriers to fully integrate these locally based organizations in an effective way into water governance. However, we found that these groups have and retain an institutional memory of the local water resource, and issues and coping mechanisms employed in the past. Even with Canada's greater experience, firm conclusions on the longevity and success of this initiative would be premature. Further research on measuring and documenting the learning these groups have in relation to the water resource is required.

Chile is only into what we could call a pilot project stage regarding stakeholders' participation, in part because of the strong centralized nature of the national's water governance.

There has been an interesting development on the establishment and distribution of potable water in rural areas. To improve access to drinking water in rural areas, community controlled drinking water systems became a goal for the Chilean government in the early 1990s. A large number of community neighborhood associations manage and operate drinking water systems to over one million people living in small towns in Chile's rural areas. In the same vein, effort has been made to address rural sanitation based on local organizations. As a result, an extended system of social capital associated with the emergence of these groups has consolidated, which is a good indicator of adaptive capacity. However, the poor coordination among government agencies has had a limited capacity to support and strengthen this development, as well as to constantly monitor quality control and sanitation. Some communities and producers are still without water rights and without water (Barrionuevo 2009) and close to half a million isolated and dispersed rural dwellers rely on trucked in water or their own wells or makeshift systems (Reyes et al. 2009). To a large extent, these limitations of water governance are related to the existence of a neo-liberal water legal framework that defines water as a market commodity.

Capacity building, with respect to information, leadership, and resources

The IPCC (2001) considers certain forms of capital, i.e., information, human, and wealth, as determinants of a social system's ability to adapt to climate change. These were identified as having vulnerabilities in the community interviews in both Chile and Canada. Community interviewees expressed considerable confusion surrounding weather and climate data sources; this confusion was also expressed by government assessment interviewees. With respect to capacity building, interviews with members of government also uncovered future potential leadership problems because of retirement and attrition. Last, one of the predominant adaptive strategies of the interviewees (rural agricultural producers) was irrigation; the fate of this adaptive strategy was found to be mired in the capacity building issue of "resources." Although having a government irrigation strategy increased resources of the agricultural producer, the strategy's implementation in the future requires government resources, which are in short supply.

Learning institutions must be able to collect and process information about key components of climate events and their impacts to alter or modify policy approaches to change. This information, of course, must be managed properly to reduce its complexity, and made available to a variety of stakeholders. Efficient data collection and data management systems are not only an indicator of a healthy institutional system, but also the fundamental components of informational capital, which is an important determinant of adaptive capacity. Both Chile and Canada have gaps in climate and water quantity and quality

data. Coordination of databases, dissemination of information, and knowledge gaps are all issues in both countries. Funding of programs oriented to collect, store, and share this data has been cut in past years, contributing to this issue rather than remedying it. This lack of information is detrimental to the development of policies able to foster adaptive capacity to climate variability and climate change.

In Canada, interviewees reported several water data collection issues. Uncertainty exists about what data is available, what information can be accessed and by who, and who is responsible for collecting and sharing data (Diaz et al. 2009). In Chile, data gaps exist that affect modeling capacities able to analyze future climate scenarios and even make projections on how ground reservoirs and glaciers will be affected. Moreover, the lack of solid information on water resources has led to a distribution of water rights that overpass the amount of water available in some basins. This has inhibited the medium- and long-term planning capacities of the water governance institutions in both Chile and Canada, both regionally and nationally (Reyes 2009, Corkal et al. 2011).

Institutional capacity to respond to water shortages appears to be in a precarious position in both countries with respect to human capital and specifically of an institutional leadership able to direct and shape the strengthening of adaptive capacity. In Canada, organizations traditionally involved in water governance are in transition, responding to changing demographics, markets, and climate; local institutional practices in Chile are threatened by the development of a water market that seems to be acting as a leading force.

In Canada no concerted and collaborative effort exists with respect to future climate change. No drought plan exists in Saskatchewan (Hurlbert et al. 2009, Diaz and Warren 2012), and Alberta's plan focuses on short-term coping strategies at the producer level. There is a need for a plan addressing the larger picture of water allocation during times of surface water shortage (Hurlbert et al. 2009). Mechanisms to address issues beyond provincial borders, and an appropriate federal water policy and plan, are lacking. Currently, most water supply and infrastructure challenges in Saskatchewan are met by municipal governments and individual farm operators. The provincial and federal government agencies with the experience and capacity to deliver rural water programming solutions to water-stressed communities and farmsteads are facing uncertain futures because of institutional rearrangements and decades of government attrition through neo-liberal policies (Diaz and Warren 2012). Each province has two main agencies facing aging, retiring, and reducing workforces. The threatened loss of the institutional capacity and of its ability to lead the process could result in both countries in a failure to plan.

The development of an irrigation structure in both countries has strengthened the adaptive capacity of agricultural

producers. Farmers with access to irrigation have a better ability to adapt to drought than those who are only dependent on rain, however, this requires resources, or financial capital, which has implications for the equity dimension of adaptive governance. This has implications for the equity dimension of adaptive governance. However, irrigation, in a context characterized by continuous water scarcities, could also be problematic, as is the case in some areas of the Canadian SSRB (Diaz and Warren 2012, Warren and Diaz 2012). Irrigation is considered a key component to expand national agricultural productivity in Chile. Using its topographic characteristics, Chile developed an irrigation infrastructure very early in its agricultural history as a way to secure access to water during its dry summers. Recent governments have expanded this infrastructure, which has resulted in placing the country among the top 10 agricultural exporting countries (Reyes 2009). In the ERB irrigation has been a life-saving mechanism against the devastating impacts of droughts. Early in the 19th century irrigation was developed that not only facilitated coping with water scarcities but has also expanded the regional export agricultural industry considerably. Access to irrigation is defined by the Water Code, which has promoted the commoditization of Chile's water resources and as a result it has tended to facilitate the productive activities of large agricultural producers.

As a product of the droughts of the 1920s and 1930s, the federal and provincial Canadian governments embarked in an institutional and infrastructure program that, among other things, promoted the development of irrigation mostly in the SSRB (ICID 2010). The development of irrigation infrastructure has been less predominant in recent decades than in Chile. Opportunity for irrigation expansion exists only in Saskatchewan in the study region, but there is no current federal or provincial government plans to support this infrastructure. In Canada this may be another disadvantage of not having a centralized government involved in water governance to a greater degree. More involvement arguably would lead to more funding of large infrastructure programs such as those required for the building of irrigation. In both countries resource capacity with respect to water and financial capital is an issue and will continue to be into the future.

Equity

The issue of equity at the present time in both countries is clearly related to the recent development of a neo-liberal regime at the political and economic level. The history of both countries during the first half of the 20th century shows that there has been a continuous process of adaptation through innovation and improvements in agricultural practices and that governance has played a central role in the development of this adaptive capacity in the rural sector and in improving the welfare of the rural population. The creation of an institutional network oriented to reduce exposure to climate events and the development of an irrigation infrastructure were perhaps the

most important resources provided by the government of the period. In the case of Chile, the process was even more radical to the extent that different national governments sought to establish a fairer distribution of agricultural resources, including the implementation of an agrarian reform in the late 1960s and early 1970s. However, a drastic change of policy, informed by neo-liberalism, has redefined the development of this adaptive capacity in both countries during the last four decades.

Institutional adaptation efforts in Chile have been mediated by a structural process of social differentiation among agricultural producers. The agricultural sector has had a significant structural transformation as a result of the neo-liberal policies adopted by the military regime (1973-1989) and continued by the democratic governments. These policies have been oriented to increase the competitive capacity of agricultural producers in the international economy, under the neo-liberal assumption that only a small number of producers are viable to compete in the conditions of the global markets. This policy approach has resulted in the creation of a modern agriculture economy that concentrates high levels of capital and produces mostly for the external market. The most dynamic sectors have profited from a large numbers of government institutional support programs, including easy access to crop insurance and water resources. On the other hand, there are a large number of small producers, with limited amounts of capital and with a production oriented to the regional and national markets, who have a very limited support from the government (Hojman 1990). This process has resulted in an unequal distribution of resources that are not only important to economic sustainability but also to reduce producers' vulnerabilities to climate.

Crop insurance, a significant resource for adapting to climate extreme events, has followed this pattern and, as a result, it has been only marginally available to small farmers. The Chilean Ministry of Agriculture developed a program to integrate small farmers to insurance services by covering up to 50% of the costs. However, only a small number of these producers can afford to pay (GORE Coquimbo 2007). Small producers complain that most of these support programs are not always timely and often do not cover the full economic impact of climatic events (Salas et al. 2009).

This pattern of distribution of adaptive capacity is also found in the distribution of water resources within most agricultural regions of Chile, including the ERB. The two main dams in the basin, La Laguna and Puclaro, were constructed and have been maintained with the technical support and initial managerial support of the Department of Hydraulic Works of the Ministry of Public Works. Three autonomous and well-structured irrigation districts manage the irrigation systems, all of them controlled by large farmers (Salas et al. 2009, 2012). This infrastructure has reduced the risks associated with

drought, enhancing water security and the adaptive capacity of regional large and medium farmers who have been able to secure water rights. However, those without access to irrigation have experienced a reduced adaptive capacity. An example of this situation has been the case of goat herders, a traditional component of the rural subsistence economy of the area, who have been reduced in numbers by 43% during the last 17 years as a result of an absence of government programs that could facilitate their adaptation to increasing aridity and deforestation (Salas et al. 2009). Moreover, many small agricultural producers with water rights have seen their water allocations taken away by larger producers because of the inability of governance institutions to act as arbiter on water conflicts.

The government's bias was clearly demonstrated during the construction of one of the dams in the study area, which resulted in the relocation onto nearby lands of the people residing in three small towns on the site of the dam exists. Relocated people complained that the compensation packages eventually negotiated did not replace the social capital lost nor traditional orchards and river habitats. Moreover, they lost their water rights, so that they cannot extract water for irrigation from a dam that is only 200 meters away, nor use it to develop income generating activities associated with tourism (Rojas et al. 2008). In these terms, proactive planning and policy development in Chile has ensured the availability of important resources that are relevant to economic sustainability and to adaptive capacity, but these resources have not been equally distributed among agricultural producers.

In Canada, climate studies have demonstrated that there is "a moderate to a high level of adaptive capacity" (Sauchyn and Kulshreshtha 2008:320) in the Canadian prairies, but this capacity is unevenly distributed (Diaz et al. 2009, Diaz and Warren 2012). First Nation communities tend to be the most vulnerable because of particular conditions that characterize the integration of indigenous people in Canada (Mazgul and Rojas 2006). Communities in dryland areas are also highly sensitive to water scarcities due to lack of access to irrigation, while communities with well-established water infrastructure (storage reservoirs and distribution networks) and that utilize irrigation in periods of low precipitation were the most resilient. As in the case of Chile, Canadian government agencies have provided incentives to a process of modernization of agriculture, mainly with the purpose of improving the competitiveness of the sector in the global markets. Government policies and agro-industry development have fostered a larger scale of production, larger farms and larger equipment, which has enabled fewer producers to produce more crops. The result of these changes has been an increasing process of social differentiation among producers, whereby traditional farms, very homogeneous in terms of size and resources, have mostly disappeared and been replaced by

a relatively small group of large farmers and by many small producers. The distribution of economic resources, an important determinant of adaptive capacity, has followed this process of social differentiation, accumulating most of these resources among the large producers. Economic and social policies have also fostered changes within the rural communities. Centralization of government services, i.e., mail, schools, health, into larger towns has negatively impacted rural life. Along with a population shift from rural to urban centers, which has resulted in a small and aging rural population, these developments have undermined the viability of many communities. All these processes have tended to concentrate resources important to adaptive capacity in a group of small producers and large towns.

There are obviously differences in the vulnerabilities and adaptive capacities between Chile and Canada, which relate to the different governance structures of each country. Although Chile has a strong central governance regime it lacks regional discretion and presence. This leaves rural communities especially vulnerable in times of disasters such as mudslides and with water programs (crop insurance and drinking water or sanitation) that have not been particularly effective. Although Canada has a strong decentralized water governance structure residing in its provinces it lacks a current well-coordinated water strategy. The large number of stakeholders and institutional arrangements has produced a fragmented approach to the management of water resources, resulting in an unequal distribution of adaptive capacity. This limited distribution, however, has not reached the extremes of the Chilean situation. Some communities in the SSRB are more vulnerable than others, but none is without some degree of access to and benefit from water for drinking and sanitation. Although crop insurance and water infrastructure programs were complained about as expensive and unsatisfactory, they were not characterized as completely unavailable.

DISCUSSION

In spite of the historical and institutional differences in structures of governance and resulting instruments of governance between Chile and Canada, there are striking similarities in vulnerability and adaptive capacity, which are noteworthy. Both countries show the same limitations in terms of adaptive capacity and specifically responsiveness. Chile's challenges relate to its highly centralized governance system; Canada, on the other hand, suffers from an excess of governance. In the latter case, the existence of a plurality of government levels, federal, provincial, and local, and a multitude of agencies at each level interfere with responding to climate extremes in a timely manner. Both countries have challenges in relation to continuous access to information and data and there are significant issues in terms of data management and dissemination. The absence of these two central features of adaptive governance contributes to the limited institutional social learning and capacity in both

countries. However, a positive development in relation to social learning, the development of local water advisory committees and their integration into watershed management, is emerging in both countries. In this regard, Canada is significantly more advanced than Chile, where the development of local committees is only in the pilot project stage. This difference seems to be in part due to the strong centralized nature of Chile's water governance and the more decentralized nature of Canada's, which is more in keeping with local groups managing local water. Thus, integration of information and full meaningful participation of different stakeholders is a challenge. Climate change concerns still do not permeate government water policy concerns, and it is too premature to know if these concerns will be raised in this process. These watershed groups have the potential to integrate and coordinate impacts of climate on water, leveraging local government action closer to the people affected by the changed climate and increased water stress. Both enabling measures, which transfer knowledge and best practices, can occur through these groups (World Bank 2010).

The capacity of both Canadian and Chilean governance structures to respond to climate change has had positive and negative developments. In both countries a decrease of social capital in relation to local government organizations is occurring. However, both countries are seeing this replaced with more active vertical involvement by civil society. It is unclear if this will reflect an increase in overall capacity into the future. Another important factor of adaptive capacity identified by those interviewed was irrigation. Chile has experienced a marked increase in irrigation as a result of its privatization of water. A significant agri-industry of large farmers exporting their product has developed. However, this adaptive strategy has had a significant impact on the adaptive governance dimension of equity.

Although vulnerable populations in Canada have been negatively impacted by climate change, and adaptive capacity is not distributed evenly, none were without some degree of access to and benefit from water for drinking and sanitation. In Chile, however, small producers have had very limited support from the government and a resulting increase in economic and social vulnerability. Some communities are without any access and rights to water, adaptive measures like crop insurance, and have not profited from the building of dams, which facilitate the expansion of irrigation. It is clear that a centralized privatized water market, as is the case in Chile, reduces equity surrounding water governance. In addition, global economic forces appear to affect both countries, resulting in vulnerability for lower socioeconomic people and people without access to water and water infrastructure. It is by far the lower socioeconomic communities and individuals with higher vulnerability whose livelihoods are more at risk as a result of climate change. Both countries face uncertainty about the resolution of water

conflicts between water rights holders in a future with more constrained water availability, data availability challenges, and risk of loss of institutional capacity.

This analysis of the governance structures in Chile and Canada shows that both systems have similar challenges in developing an institutional adaptive capacity able to respond to the potential risks associated with climate change and its impacts on water resources. To some extent, the sources of these challenges are related to governments' embrace of neo-liberalism as a strategy of development. In both cases there has been a strategy characterized by the limited role of the state in the economy and an overemphasis on the active role of the private sector as the main economic engine, a neo-liberal approach that has been accompanied by enthusiastic support for economic development and a cosmetic attention to environmental issues. This strategy is resulting in an increase of risk to many rural agricultural producers and is facilitating adaptation to climate extremes in only a select group of producers. This is very widely known in the Chilean case, where the adoption of neo-liberalism has been especially detrimental in terms of water resources. The adoption of a neo-liberal water code, whereby water is considered a privately owned commodity, has been an imposition of a top-down system that has not only limited the capacity of governance to establish adaptive water strategies at the regional level, but also has imposed a process of competition in a context characterized by an unequal distribution of power (Galaz 2003, Boelens et al. 2011) resulting in an adaptive capacity to water scarcities that is concentrated in a small number of large producers with the ability to have easier access to water rights.

This issue, the predominance of a worldview such as neo-liberalism that imposes a direction and an organization of resources on governance, emphasizes the possibility of a disjunction between adaptive governance and good governance, in which bad governance, that which disregards the dimension of equity, is possible even though governance practices are adaptive or vice versa. More theoretical and empirical research is required to explore the differences between and overlapping of these two forms of governance and on the role that the neo-liberal worldview plays in contributing or increasing the adaptive capacity of governments and the fair distribution of an adaptive capacity.

CONCLUSION

In this paper we analyzed the Chilean and Canadian structures of water governance in the context of adaptation to climate change based on data collected in community vulnerability assessments in Chile and Canada and a related assessment of the interconnection of water governance to these vulnerabilities, as well as the capacity of governance to support the rural community in adapting. The data exposed a large adaptation gap. This data was then analyzed in relation to four dimensions of adaptive governance arising from the

community vulnerability interviews: responsiveness, learning, capacity, and equity.

To respond to the increasing uncertainty of climate, and improve the adaptive capacity of the most vulnerable, adopting the institutional design principles of adaptive governance is necessary. To be able to do this, we need qualitative changes in the institutional approach to climate change, so that our institutional systems can fit with the new biophysical systems emerging from the process of climate change. To meet the challenge of climate and build adaptive water governance, two basic changes must be met.

First, we need to abandon the neo-liberal idea that the private sector has to be the central core of the organization of society. The private sector, for the purpose of leading the climate change effort, is too amorphous. It contains a diversity of conflicting interests, and many of them are in contradiction with that effort. Moreover, neo-liberalism is a producer of multiple risks given that its rationality is not directed to the common welfare, but to the specific economic interests of private companies. The predominance of the neo-liberal market for water and irrigated produce in Chile, with the resulting impact on societal inequity, substantiates this conclusion.

A second change involves a more direct and active intervention of the state in organizing and leading the climate change effort. The state is the only actor, at the national level, that has the capacity and resources to implement climate change policies, programs, and approaches at regional and local levels (Giddens 2009, World Bank 2010). Local institutions, however, are also important in that they integrate the interests and concerns of local people and facilitate the management of local resources, and cannot be ignored (Agrawal 2010, Christoplos et al. 2009, Ensor and Berger 2009) but their resources are limited. They must be part of what Adger (2003) refers to as synergistic social capital, where local institutions link with a larger institutional framework, mainly public institutions, that could provide access to larger and better resources and the necessary coordination led by an enabling state (Giddens 2009). These collaborative arrangements are not only important to secure political agreement around the climate change agenda, but also to establish forms of governance that could channel the participation of civil society in the implementation of collective tasks oriented to secure the resiliency of society.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/6148>

Acknowledgments:

This article is the product of two research projects: the Institutional Adaptation to Climate Change (IACC) and the Rural Communities Adaptation to Drought (RCAD). Funding for these two projects was generously provided by the Social Sciences and Humanities Research Council of Canada.

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