

Water Governance in Chile and Canada - A comparison of adaptive characteristics

Margot A. Hurlbert¹ and Harry Diaz²

Abstract:

The paper compares the structures and adaptive capacities of water governance regimes which 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 multi-level 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 supplemented by 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 semi-structured qualitative interviews. Based on this comparison, conclusions are drawn on the adaptive capacity of the respective water governance regimes based on five dimensions of adaptive governance which include: responsiveness and flexibility; reflexivity and social learning (which enhances institutional memory and trust); continuous access to information (allowing the capacity to respond and change autonomously); capacity (including leadership and resources); 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.

Keywords: Climate change, extreme weather, adaptive governance, water governance.

¹ Associate Professor, Joint Appointment, Department of Justice Studies and Department of Sociology and Social Studies, University of Regina, Canada

² Professor, Department of Sociology and Social Studies, University of Regina, Canada

1. Introduction

Although many groups in society have a history of accommodation to climate conditions, anthropogenic climate change challenges this traditional coping range. Contrary to the perception that climate change will have a uniform effect – a warming of the whole planet through a linear, gradual process where the different components of the climate system continue more or less in equilibrium – there is increasing consensus that there may be a readjustment among the components of regional climate systems creating conditions of unexpected climate patterns including changes in sea levels, precipitation patterns, river floods, water scarcities, and significant transformations in regional ecosystems, including the disappearance of many species and the invasion of non-native species (Parry et al., 2007). More intensive and longer droughts are expected in many world regions, including large sections of Africa, Australia, North America, South America, and Europe. Heat waves, a long number of days with unusually high temperatures, are expected to impact people, animals, and plants, especially in large urban centers that have been built for cooler times (Parry et al., 2007; Brown, 2007; Henson, 2006). In these terms, it is expected that an increasing variability of climate patterns could go well beyond the existing adaptability range of these groups

The arguments about a potential “tipping point” in the near future add another level of complexity to our understanding of the potential impacts of climate change on the basins. A tipping point is a threshold beyond which global warming could be potentially very dangerous due to positive-feedback processes which intensify changes, making them worse. Many scientists believe that an increase of 2°C above pre-industrial levels is the threatening threshold. This tipping point could be reached when the concentration of carbon dioxide arrives at a level of 450 ppm in the atmosphere. By 2007, the level of concentration was already 380 ppm, getting very close to this threshold (Henson, 2006: 16; Brown, 2007: 42-45). Some authors (Pearce, 2007; Lovelock, 2007) embrace this idea of the process of climate change as non-gradual and potentially dangerous, arguing that climate change could involve a radical process that brings sudden and abrupt changes to natural and social systems and their equilibriums. These and other potential severe consequences of climate change create conditions of extreme risk not only for the people living in both basin but also for millions of people around the world resulting on large financial losses, severe societal stress, and severe humanitarian disasters.

Vulnerability to climate change can be exacerbated by the presence of other non-climate stresses. Climate, when it is coupled with other stressors, could be highly problematic. Climate could either exacerbate the already negative impacts of non-climate 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 the proportion of human beings that are in an extremely vulnerable situation in the context of climate change (Parry, 2007: 19; Timmons, 2009; Christoplos et al., 2009).

The institution of governance is a key determinant of the vulnerability of people in responding to climate change and variability, as well as in relation to other stressors. 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 governance institutions are adaptive is crucial for reducing vulnerability and increasing resilience..

The paper compares the structures and adaptive capacities of water governance regimes which respond to water scarcity or drought in the South Saskatchewan River Basin (SSRB) of western Canada and the Elqui River Basin (EB) in northern Chile. The SSRB and the EB represent two large, regional, dryland water basins with significant irrigated agricultural production and strong similarities.

The SSRB is one of the largest basins in Canada, covering approximately 166,000 square kilometres, extending from the Rocky mountains to Lake Winnipeg and encompassing three provinces: Alberta, Saskatchewan and Manitoba. Its climate is determined by its location. The Rocky Mountains to the west impede easy access of moisture-bearing winds from the Pacific Ocean. As a consequence, most of the basin has a continental climate, subhumid to semiarid with short hot summers (mean temperatures from 14°C to 16°C), long cold winters (mean temperatures from -12.5°C to -8°C), low levels of precipitation (with mean annual precipitation extremely variable but generally increasing northwards from less than 300 mm to 600 mm per year, and also increasing towards the eastern and western margins of the basin), and high summer evaporation. A water deficit is a characteristic of this area—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 & Kulshreshtha, 2007; Lapp, 2009).

The ERB is the northernmost basin of the Coquimbo region in northern Chile. It spans 9,675 km², from the Pacific coast to the Andes Mountains and it is geographically located between the northern desert of Atacama and the semi-arid Mediterranean climate of the Chilean central region.. Its climate is influenced by the pacific sub-tropical anti-cyclonic systems that moves north during the winter, allowing low pressure systems to bring precipitation one or two months of the year to the valley, where the majority of agriculture takes place and where the majority of communities in the basin are located. Average precipitation is 100 mm per year, although it may double or triple during the wet El Niño phase of the El Niño Southern Oscillation (ENSO), and be half the average or less during the dry La Niña phase of ENSO. Regional records show a decrease in precipitation over the past century from between 150 and 180 mm per annum in the early 1900s to the currently experienced 100 mm. In the last 25 years, the decreasing 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 represents a risk that affects both human and natural systems (Cepeda, 2009). Future climate change scenarios show a trend towards 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 precipitation, which are already low enough (Fiebig-Wittmaak, 2009).

Although similarities can be drawn between the two study regions in respect of future climate conditions expected, significant differences exist in respect of governance institutions. The Canadian governance situation is characterized as decentralized multi-level 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. These differences, however, are reduced by the fact that both governments have adopted a neo-liberal strategy of development, characterized by a market-driven approach and by a reduction of collective action. Chile has embraced neo-liberalism in a more radical way –with its own particular impacts on natural resources such as water--, meanwhile Canada still maintains many of its social programs and a more active intervention of the state on social and economic issues.

The methodological framework for this study was established in a document defining institutions as the main dimension of a governance assessment (Diaz & Rojas, 2006), together with a baseline description of water governance in Canada (Hurlbert, 2006a; Hurlbert, 2006b; Corkal et al., 2006) and Chile (Diaz et al., 2005). This structural comparison has been supplemented by studies carried out in each region assessing the adaptive capacity of governance institutions through semi-structured qualitative interviews and focus groups. Reports were prepared in Canada and Chile respectively by the separate teams conducting the research (Diaz et al., 2009; Reyes et al., 2009). Based on this comparison, conclusions are drawn on the adaptive capacity of the respective water governance regimes based on a set of dimensions that should characterize adaptive governance. 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, and potential factors affecting both structures. Determining which institutional systems increase adaptive capacity becomes germane.

2. The Dimensions of Adaptive Governance

Adaptive governance (sometimes termed adaptive management) recognizes that the present, past and future of human and biophysical systems are closely and intricately interconnected. Significant challenges are then posed for policy developers and decision makers including complexity, uncertainty and change, and problems of fragmentation (Holling, 1978; Gunderson, 1999; Dietz et al, 2003). Adaptive governance has emerged from the literature surrounding resilience and complexity theory (Berkes and Folke, 1998). Social-ecological resilience is the amount of disturbance a system can absorb and still remain within the same state or domain of attraction, the degree to which a system is capable of self-organizing, or the degree to which the system can build and increase the capacity for learning and adaptation. Resilience refers to persistence or robustness of natural or human communities in the face of disturbance and how can innovate in the face of complex, fast or slow changes, drawing on institutional memory and the ability to self-organize, recombine structures and processes, renew systems and find new ways (Folke, 2006, 253). When a vulnerable social-ecological system has lost resilience it has suffered a loss of adaptability (Berkes and Folke, 1998, 262). Governance needs to understand ecosystem dynamics and sources of social and ecological resilience and actively manage to deal with the interplay of gradual and abrupt change. From this need, “adaptive governance” emerges. In these terms, the concepts refers not only to the capacity of governance to face and reduce the impacts of external stressors upon its internal institutions but also to its capacity to extend this resilience to a variety of systems that, although are not directly part of governance, are under its influence. For the purposes of this paper, adaptive governance is defined as:

Adaptive governance is that governance that spans a range of political, social, economic, and administrative systems and develops, manages, and distributes a

resource in a manner that promotes resilience through collaborative, flexible, and learning-based issue management across different scales.

Adaptive governance operates at multiple levels and relies on different underlying sources of authority (Burris et al., 2005; Lebel et al. 2006). In relation to water, adaptive governance is sited as 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 Stiffler, 2005). Dimensions of adaptive governance developed based on the adaptive management and governance literature (Huitema et al., 2009; Folke et al. 2005; Gunderson, 2002; Olsson et al. 2006) are:

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.
 2. Reflexivity – the social learning aptitude of water and extreme climate events governance institutions.
 3. Access to information in such a way as there is an ability and capacity to respond and change autonomously.
 4. Capacity – the informational, human, and social capital in existence necessary to respond appropriately to climate variability, hazards, and extreme events.
- Equity – the fairness of the water and extreme climate events governance regime in process and impact.

These dimensions will be used to analyze the governance of water in both Chile and Canada.

3. Water Governance Structures in Chile and Canada

Government systems are radically different in Canada and in Chile. Canada has adopted a federal system, where 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 that exist 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 yet in existence. Although some areas 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, multi-level governance with assigned water licenses (Hurlbert, 2006b; Johns and Rasmussen, 2008; Bakker, 2007).

Chile has a central government, where 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, where water rights are treated as private property, so they could be sold, rented, and transferred to other people. The government has a very limited role in administering water transactions and water conflicts, since they are defined as issues to be

resolved between private individuals. Given that in some areas water resources are fully allocated local communities, small, medium or poor farmers may be without water rights and without the means to purchase any water rights (Reyes et al., 2009; Bauer, 1998, p. 67).

4. Comparison of adaptive capacity of governance in Chile and Canada

a. Responsiveness

Coordination, integration, and conflict management are all challenges limiting the responsiveness and flexibility of water governance in both Canada and Chile. The centralized decision-making of the Chilean government limits the activities of regional water agencies and local governments. Regional agencies have very limited discretionary power to change water policies and staff resourcing such that centralization is a recurrent complaint among regional agencies associated with water (Reyes et al., 2009). At the regional and national level, multi-agency coordination and planning is weak (Salas et al., 2009, p. 19). Planning is reactive, not proactive (ibid., 2009). Local governments are first responders for climatic events, but they lack the administrative and technical capacity to respond to water contamination or other management issues, limiting their activities to trucking in water to areas that for several reasons may experience water shortages. Local governments also could pass environmental by-laws in their areas of jurisdiction, but apparently lack the technical capacity to do so (Chilean Integration Report, 2009).

In Canada, a multitude of water organizations exists at the provincial and municipal level, making interagency coordination an issue. Complexity creates confusion even amongst government officials themselves, let alone stakeholders and the general public. A need to establish clear roles and coordinate water activities was discovered in participant interviews and focus groups. A further constraint of “first in time/first in right” licensing exists. Although water transfers are allowed in Alberta, one of the two provinces that are part of the SSRB, the development of further irrigation systems and the provision to new rural residents (including some municipalities) is constrained by this system.

Currently, most water supply and infrastructure challenges in Saskatchewan, Canada, are met by municipal governments and individual farm operators. The provincial and federal government agencies with experience and capacity to deliver rural water programming solutions to water-stressed communities and farmsteads are facing uncertain futures due to institutional rearrangements and decades of government attrition through neo-liberal policies. If the two main agencies, the federal Agri-Environment Services Branch and the provincial SaskWater agency were to disappear, a deficit in capacity and a major vulnerability would result. Alberta faces similar challenges with the threat to long-time Alberta Environment and Alberta Agriculture employees who may eventually retire or be replaced with people of lesser knowledge.

The vertical and horizontal institutional coordination and integration may be improved by the effective integration of civil society into governance networks. This may improve the capacity of public organizations to learn, to obtain information and to disseminate it. However, 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

(uncommunicative, non-interactive organizations and practices). The existence of these linkages allows for the flow of information, resources and knowledge in multi-sectorial and multi-level governance processes, creating the conditions for learning and adaptiveness.

Both countries will increasingly face water shortages and potential conflicts amongst current water rights holders as a result of climate change. Neither country has well established institutions to respond to these conflicts. 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. Not planning for increased conflict as a result of water shortages due to climate change increases vulnerability leading to further reductions in adaptive capacity (Rojas et al., 2008). It is not clear that either the arrangement in Chile or Canada has the necessary responsiveness or flexibility to respond to the changing climate in the future.

b. Reflexivity and social learning (which enhances institutional memory and trust)

One of the most important changes that are required, and a challenge in itself, is the development of flexible or adaptive policies, those that are reflexive or “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 & Drexhage, 2009, p. 1). Rigid policies that are unable to cope efficiently with the uncertainties and dynamics of new climate conditions are obviously a serious obstacle that has to be overcome in the two countries. Adaptive policies, to be effective, must be supported by a public institutional system that is able to reflex about and to learn constantly from those other systems with which it interacts and from its own experiences. Institutional learning increases the capacity of public organizations to deal with a multiplicity of challenges, and change trajectories and practices as required. 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, the capacity to collect and process information about key components of systems (in our case, climate events and their impacts) where policies and programs are being applied, so that we are able to know the pace of change of these components and the degree of success of these policies and programs in coping with change. This capacity is predicated on the ability to collect and share data discussed in the next section. The second institutional condition is the vertical and horizontal coordination and integration of institutions discussed previously, 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 allow for reflexivity and social learning.

Integrated watershed management has emerged for consideration in both countries which is consistent with its adoption as a best practice (Global Water Partnership, 2009). Canada is significantly more advanced than Chile in this regard and Chile is really only in the pilot project stage. This may be in part due to the strong centralized nature of Chile’s water governance and the more decentralized nature of Canada’s. Decentralization is more in keeping with local groups managing local water. Even with Canada’s greater experience with watershed groups and

integrated watershed management planning of several years, firm conclusions on the longevity and success of this initiative would be premature.

c. Access to information (allowing the capacity to respond and change autonomously);

Learning institutional systems must be able to collect and process information about key components of climate events and their impacts in order 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, they are also the fundamental components of informational capital (which is an important determinant of adaptive capacity). As relevant as other forms of capital – economic, social, and human – informational capital contributes to a better knowledge of the existing resources, facilitating their management in situations of uncertainty and surprise. The existence of a solid accumulation and good use of information capital is a must in ensuring the social and economic sustainability of livelihoods and productive sectors.

Both Chile and Canada have gaps in climate and water quantity and quality data. Coordination of data bases and knowledge gaps of what data exists are issues. Funding of programs collecting, storing and sharing this data have 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, many water data collection issues were reported by interviewees. Identified gaps in the data pool (water quality, quantity and use, and climate data) were identified. Uncertainty exists about what data is available, what can be accessed by whom, and who is responsible for collecting and sharing (Diaz et al., 2009, p. 53). If the status of the water resource is currently uncertain, it is difficult to make determinations about resilience and adaptation in the face of climate change. Challenges surrounding data availability have contributed to a deficit in long-term planning (Corkal et al. 2011). No concerted and collaborative effort exists in respect of future climate change, and often planning is limited by the election cycle. No drought plan exists in Saskatchewan (Hurlbert et al., 2009), 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 (Wandel, 2009). Mechanisms to address issues beyond provincial borders, and an appropriate federal water policy and plan, are lacking.

In Chile, significant water quality, quantity and climatic data gaps exist which affect modelling capacities able to analyze future climate scenarios and even make projections on how ground reservoirs and glaciers will be affected. This inhibits the medium- and long-term planning capacities of the water governance institutions, both regionally and nationally (Chilean Integration Report, 2009).

The data gaps existing in both Chile and Canada are concerning for responding to climate variability and extremes into the future. Social learning may be impaired as a result and governance structures incapable of adapting and thus reducing vulnerability to the range of climate events expected. In Canada, challenges surrounding data availability have contributed to

a deficit in long term planning. No concerted and collaborative effort exists in respect of future climate change and often planning is limited by the election cycle. No systematic and comprehensive drought plan exists in Saskatchewan (Hurlbert et al., 2009) 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 (Diaz, 2009). Addressing issues beyond provincial borders and an appropriate federal water policy and plan is lacking. Election cycles in both countries make long term planning in relation to water an issue.

In both countries, climate change science has generally a very long term perspective, from twenty to fifty year time frames, yet governments rarely set binding legislation and policy with a planning time frame further than a few years into the future. These time frame disparities make it very difficult for effective policies, plans, legislation and regulations to be prepared and adopted in response to anticipated climate change. Large investments in water infrastructure required to adapt to future droughts anticipated by climate change are costly and hard to implement for political parties interested in re-election in a few years especially in difficult economic times

d. Capacity (including leadership and resources)

Institutional capacity to respond to water shortages appears to be in a precarious position. Organizations in Canada traditionally involved in water governance are in transition; local institutional practices in Chile are threatened by the development of a water market. This development is threatening the Chilean social capital available to respond to extreme events. In Canada social capital is threatened by an aging, retiring, population. Irrigation on both countries strengthens the adaptive capacity of the irrigated farming industry with implications for the next dimension of adaptive governance of "equity."

The study in Chile concluded that a significant threat was the loss of the social capital associated with community drinking water committees, while in Saskatchewan a significant threat was the loss of institutional knowledge on water adaptation at SaskWater, the community drinking water institutions, and the federal government department of Agri-Environment Services Branch (AESB, formerly PFRA). SaskWater is the leading provincial institution with knowledge and skill in providing drinking water solutions to people and communities in Saskatchewan; the latter institutions PFRA is an institution with the knowledge and skills to provide assistance to farmers in managing and responding to dry conditions including with infrastructure needs, crop needs and other informational needs. The threatened loss of the institutional capacity may be a result in both countries of a failure to plan for climate change adaptation and increasingly neo-liberal policies. The impact of this in Chile is the privatization of the water sector and increased reliance on the market; in Canada it is the reduction of government bureaucracy and resultant services.

There have been important positive developments that certainly have reduced the exposure of rural communities to water scarcities in both countries. 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. More than 500 community neighbourhood associations manage and operate drinking water systems to over one million people living in

small towns in Chile's rural areas. An extended system of social capital associated with these groups is a significant indicator of adaptive capacity. As well, effort has been made to address rural sanitation. Some communities, however, 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). However the poor coordination among government agencies has had a limited capacity to support and strengthen this development, as well as to monitor quality control and sanitation.

In several Chilean regions a new institutional development, called the "Water Dialogues", has emerged. "Water Dialogues" is a pilot project for integrated watershed management attempting to include a diverse set of institutions and multiple stakeholders in developing a common regional water agenda (GORE, 2007). However this process is just commencing and its ability to address the issues of coordination and poor local capacity to manage water issues has yet to be seen. It may be several years before a watershed authority in the study region is established as only three pilot projects are currently commencing in Chile. Integration of information and meaningful participation of different stakeholders will be 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.

In Canada there are many civil society organizations throughout Saskatchewan and Alberta participating in decisions relating to specific watersheds. In Saskatchewan, the Watershed Advisory Committees, organized by the Saskatchewan Watershed Authority, participate in an advisory role in the preservation and management of water resources. In Alberta watershed groups and watershed councils exist, all organized under the provinces new *Water for Life Strategy*, created after Alberta recognized the province to be facing significant pressures on its water resources. As in the case of Chile, there are still considerable institutional barriers to integrate these local based organizations in an effective way into water governance.

Irrigation is considered a key component to expand national agricultural productivity. 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 ten agricultural exporting countries (Reyes et al., 2009). In the ERB irrigation has been a life-saving mechanism against the devastating impacts of droughts. Between 1915 and 2003 there were eleven years of extreme drought (less than 30mm of precipitation) and sixteen years of moderate drought (30-60 mm of annual precipitation) in the area where the basin is found. These periods have been accompanied by a steady decrease in regional precipitation during the last half of the twentieth century (Carrasco et al, cited in Fiebig et al, 2008). As in other parts of the country, adaptation to water scarcities has occurred in the form of the development of a strong water infrastructure and irrigation schemes, which started early in the nineteenth century aimed at regulating the distribution of water during periods of water shortages. This development has not only facilitated coping with water scarcities but has also expanded the regional export agricultural industry has considerably. Access to irrigation is defined, however, by the Water Code, which has promoted the commoditization Chile's water resource and as a result it has tended to facilitate the productive activities of large agricultural producers.

The SSRB is also located within a region that has also experienced several multi-year droughts during the last century. As a product of the droughts of the 1920s and 1930s, the federal and provincial governments embarked in an institutional and infrastructure program that, among other things, promoted the development of irrigation. Most of the irrigation infrastructure in Canada is found in the SSRB: Saskatchewan has approximately 11% and Alberta well over 60% of Canada's irrigated land (ICID, 2010). The development of irrigation infrastructure has been less predominant in recent decades than in Chile. Water supplies are already fully allocated in Alberta's portion of the basin, so the possibility of expanding irrigation as a coping capacity against future droughts is limited. Opportunity for irrigation expansion exists only in Saskatchewan in the study region but no current federal or provincial government plans to support this infrastructure exists. 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 a decrease of capital in relation to local government organizations is occurring, however both countries are seeing this replaced with more active involvement by civil society. It is unclear if this reflects an increase in capacity in respect of adaptive governance into the future. Chile has experienced a marked increase in irrigation as a result of its privatization of water. This adaptive strategy has had a significant impact on the following characteristic of adaptive governance, equity.

e. Equity

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, resulting 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 number of government institutional support programs, from the availability of credit to access to markets. On the other hand, there are a large number of small producers, with limited amounts of capital and with a production oriented to the internal markets. Small producers have had a very limited support from the government and as a result have diminished their capacity to compete in the markets (Hojman, 1990) resulting in an increasing economic and social vulnerability. In these terms, the institutional adaptive capacity developed by the government has been oriented to increase productive capacities of modern farmers at the exacerbation of other producers. This is also reflected in the cases of crop insurance, the distribution of water resources, and impacts of the construction of large dams.

Crop insurance, a significant form of adaptation to climate extreme events 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 can afford to pay (GORE, 2007). Government support programs such as these are not always timely and often do not cover the full economic impact of climatic phenomena (Salas et al., 2009).

This pattern of distribution of adaptive capacity is also found in the distribution of water resources within the ERB. In the ERB the upstream La Laguna Dam was built in 1941 and the Puclaro in the late 1990s 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 (Salas et al, 2009). These efforts have reduced the risks associated with drought, enhancing water security and the adaptive capacity of large and medium farmers who have been able to secure water rights. However those without rights have experienced reduced adaptive capacity. Such has been the case of goat herders, a traditional component of the subsistence economy of the area, who have been reduced in numbers by 43 percent during the last seventeen 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 producers with water rights have seen their water allocations taken away by force by larger producers due to the inability of governance institutions to arbitrate 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 found on the grounds where the dam today 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 it is only 200 metres away, nor use it to develop income generating activities associated with tourism (Rojas et al., 2008). In these terms, proactive planning and policy development to fairly distribute adaptive capacity, especially among the most vulnerable people, is required.

In Canada, interviews with participants, focus groups, studies of water related conflicts, and historical studies all confirmed that droughts results in institutional innovations and infrastructure development, which has increased significantly the regional adaptive capacity. The same studies, however, confirm that this adaptive capacity is not distributed evenly. First Nation communities tend to be the most vulnerable due to particular conditions that characterize the integration of indigenous people in Canada (Mazgul and Rojas, 2006). Communities in dry-land areas are also highly sensitive to water scarcities due to lack of access to irrigation and small and aging populations. Communities with well-established water infrastructure (storage reservoirs and distribution networks) and who utilize irrigation in periods of low precipitation were the most resilient. Further harm to communal identity and stability, people's sense of heritage, cultural integrity, informal systems of governance and trust-based relationships often are not part of policy and focus by water governance institutions. Preserving this social capital, new styles of policy building and development relating to ecosystem and environmental preservation, are often neglected by institutions but would assist in building local and rural resilience.

The differences in the vulnerabilities and adaptive capacities between Chile and Canada do relate to the different governance structures of each country. While 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. While

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. Some believe not having a federal Canadian water policy is a disadvantage especially in relation to preventing the privatization of water and ensuring the human right to water for all (Barlow, 2007).

5. Conclusion

In spite of the historical and institutional differences between Chile and Canada, there are striking similarities in vulnerability and adaptive capacity, which are noteworthy. These similarities are in part due to the predominant influence of a global market economy on water governance institutions. This economic social structure has contributed to unequal distribution of economic resources and adaptive capacities in both countries. Government deficits and spending reductions associated with a global market economy have also contributed to reduced government safety programs, data collection and monitoring, and local presence. A counter influence has been the creation of local watershed groups and integrated water management (albeit only in a pilot experimental stage in Chile). However the sustainability of these groups is highly questionable into the future in both countries. Perhaps the mandate of these groups is too focused on water and not focused enough on community social capital building. Individuals and households suffering impacts of climate change which will include health and economic repercussions may have little time and receive little assistance from one group focused on only water.

The uncontrolled process of climate change and its increasing uncertainties have taken us to a climate change crisis point. The assumption that high-carbon economic growth is a viable alternative --in the sense that it could bring a process of ecological modernization in the near future-- is undoubtedly false, given that it only contributes to speeding up the process of global warming and its associated risks. There is an increasing urgency to act now in order to deter the dangerous path of global warming and improve the capacities of society – especially of those who are most vulnerable – to build resiliency to the impacts of climate change. Climate change has to be a front-of-the-mind issue for society if we want to manage the uncertainties of the near future, so that we could increase the positive dimensions of climate change and reduce the negatives. To be able to do this, we need qualitative changes in the institutional approach to climate change, so that our institutional systems could fit with the new biophysical systems emerging from the process of climate change.

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. In the Chilean case, the adoption of neo-liberalism has been especially detrimental in terms of water resources. The adoption of the Water Code has been an imposition of a top-down system that has limited the capacity of governance to establish water strategies and imposed a process of competition in a context characterized by an unequal distribution of power (Galaz, 2003, Boelens et al, 2011).

What is interesting in the comparison between the two countries is that despite differences in terms of the government systems they show the same limitations in terms of developing the adaptive capacity. Chile's challenges relate to its highly centralized governance system and the draconian institutional role that its Water Code imposes on the distribution of water resources. Decision-making processes are highly centralized in the main ministries of the national government, with the Ministry of Finances playing a central role in the allocation of economic and institutional resources. The facts that all the ministries are based on Santiago add even more weight to the centralization of power and decision-making. Canada, on the other side, suffers from excess of governance. The existence of a plurality of government levels –federal, provincial, and local -- and a multitude of agencies at each level interfere with the capacity to face the challenges presented by global change.

Both countries have challenges in continuous access to information and data. There are significant issues in terms of data management and disseminations. The absence of these two characteristics of adaptive governance contributes to the difficulty being experienced in relation to social learning and reflexivity 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. Canada is significantly more advanced than Chile in this regard; Chile is really only in the pilot project stage. This may be in part due to the strong centralized nature of Chile's water governance and the more decentralized nature of Canada's. Decentralization is more in keeping with local groups managing local water. Integration of information and meaningful participation of different stakeholders will be 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 practice can occur through these groups (World Bank, 2010: 335).

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 involvement by civil society as just discussed. It is unclear if this will reflect an increase in overall capacity in respect of adaptive governance 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 characteristic of equity.

Although vulnerable populations in Canada were 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 a very limited support from the government and a resulting increase in economic and social vulnerability. Some communities are without any access to and rights to water, adaptive policies like crop insurance, and have been harmed by the building of dams (which facilitates the expansion of irrigation). It would appear that a centralized privatized water market reduces equity surrounding water governance. In addition, global economic forces appear to affect both countries, resulting in vulnerability for lower socio-economic people and people without access to water and water infrastructure. Adaptive capacity is unequally distributed in both countries. It is by far the lower socio-economic 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.

Accountability in respect of water governance is challenging in both Chile and Canada. Research interviews identified a weak accountability in respect of disaster relief, and contamination after floods and mudslides in Chile. However, in Canada respondents identified the lack of data availability, and adequate planning due to election cycles impacting the absence of federal water policy. It was believed that without this policy, accountability for planning and decisions surrounding water suffered.

In order to meet the challenge of climate change and build adaptive water governance, two basic changes are a must.

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 interests, and many of them are in contradiction with that effort, especially as illustrated herein in respect of equity. Moreover, its rationality is not directed to the common welfare, but to the specific economic interests of private companies.

A second change involves a more direct 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 address the failures of markets, to lead the private sector and civil society, to facilitate the production and delivery of resources, and make possible the implementation of climate change policies, programs, and approaches at regional and local levels (Giddens, 2009; World Bank, 2010). Local institutions, however, are also important – 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 & 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.

Addressing the climate change challenge also requires changes to the traditional approach of the public sector to environmental problems. There is growing literature in different areas related to global change, sustainable development, natural resources management, and climate change that provides important insights into the nature of these changes. Building on these experiences, we emphasize the need for two important transformations of the state: the collaboration of the civil society, and modifications to the action and the instruments of the state. A necessary change involves the integration of non-public actors in the process, a process that takes us from government to governance. It is necessary to avoid the traditional top-down process, where the state dictates strategies and defines conditions and norms. Rather, it is fundamental to pursue collaborative institutional arrangements that incorporate local governments, community organizations, and the private sector. This is what Giddens calls “the enabling state,” which has as “its prime role ... to help energize a diversity of groups to reach solutions to collective problems” (2009, p. 69). 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.

Changes to the instruments of the state – policies and programs – should be complemented with changes to the organizational processes that inform the actions of the state – its internal decision-making and managerial processes. Dimensions of adaptive governance must be guiding principles in the establishment of these policies and programs. Policy makers must ensure that water governance is responsive and flexible, advances social learning and reflexivity, allows continuous access to information, builds capacity including leadership and resources, and advances both equity and accountability. These changes are directly related to the development of new collaborative partnerships between the government and civil society and to the development and implementation of comprehensive climate policies and climate policy integration. Given the short history of the emerging collaborative institutional arrangements of local water advisory groups, these changes and recommendations have yet to be implemented. The focus of these groups has been on local water quality; expansion and integration with climate policies and programs has yet to occur. Climate is currently managed in both Chile and Canada by another branch of government with weak ties to the water advisory groups.

Climate change is increasingly understood to entail more than a gradual, uniform increase in global temperatures; it entails unexpected climate patterns, potential tipping points, and greater variability and significant climate events. As an environmental and social problem, climate change has unique global and local issues. This paper has focused on impacts of climate change on water, adaptive capacity, and governance informed by an empirical assessment of water governance networks in Canada and Chile. Both study regions in Chile and Canada face risk and future uncertainty surrounding climate. This will have a real impact on communities’ and people’s livelihoods. This changing climate will also bring certain opportunities, and lessons can be learned from both the Chilean and Canadian case study on the reduction of vulnerabilities and the improvement of resiliency in the future through improved adaptive climate governance arrangements.

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About the authors

Margot Hurlbert is an Associate Professor jointly appointed to the Department of Justice Studies and the Department of Sociology and Social Studies at the University of Regina. Her fields of research include water, marginalized peoples, energy and environmental governance. Margot is leading a project on participatory watershed governance in Western Canada and participating in a project on energy sustainability, another project on drought policy, and participating in an international comparative study on the impacts of extreme climate events in Argentina, Brazil, Canada, Colombia, and Chile.

Harry Polo Diaz is Professor of Sociology and Social Studies and Director of the Canadian Plains Research Center (CPRC) at the University of Regina. His fields of research include adaptation and vulnerability to climate change, water scarcities, and environmental governance in Canada and Latin America. Polo is currently leading a research project on the impacts of drought on rural communities in the Canadian prairies and participating in an international comparative study on the impacts of extreme climate events in Argentina, Brazil, Canada, Colombia, and Chile.

