Institutions and Adaptive Capacity to Climate Change

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1. Introduction

The IACC project addresses the capacity of institutions in dry land regions to adapt to climate change impacts. The **goal of the project** is to develop a systematic and comprehensive understanding of the capacities of regional institutions to formulate and implement strategies of adaptation to climate change risks and the forecasted impacts of climate change on the supply and management of water resources in dry land environments. The project addresses this goal through a comparative study of regions at different stages of social and environmental vulnerability: the South Saskatchewan River Basin (SSRB) in western Canada, and the Elqui River Basin (ERB) of north-central Chile. Based on well established and credible scenarios that forecast increasing climate change induced droughts in the two study regions-- the project has chosen water as a terrain of investigation or microcosm that can contribute to the understanding of the wider problem of adaptations to climate change (Diaz, et. al, 2003/4).

The **purpose of this paper** is to contribute to the development of the project research design by discussing conceptual and methodological issues related to institutional adaptation to climate change. In our project several interrelated activity clusters are organized around a central issue: the vulnerability of rural communities to the impacts on water resources of climate variability and climate change. These clusters involve (a) an ethnographic vulnerability assessment of a group of selected communities in the two basins; (b) an assessment of the role played by formal public and private institutions in reducing the vulnerability of these communities; (c) a historical evaluation of the role played by institutions in periods of water scarcity; (d) an analysis of the role played by public institutions in the resolution of rural water conflicts; (e) a definition of future scenarios of climate change for the two regions; and (f) discussions with stakeholders to about the current and future vulnerabilities of the communities and the role played by formal institutions.

The **focuses of this paper** are on conceptual and methodological issues related to the second cluster (b): the evaluation of the roles played by formal public and private institutions in reducing the vulnerability of the rural communities. It complements other papers developed within the project (Smit, Wandel and Young, 2005; Morito 2005). It reviews principles, processes and experiences of institutional adaptations to climate change, with a focus on climate change induced water scarcities. It explores approaches that claim to guide "successful institutional adaptation" or "high adaptive capacity" to climate change-induced or heightened vulnerabilities (social and physical/ecological or environmental). However, the inquiry is conducted acknowledging from the start, that there is a risk in the attempt to find easy-to generalize principles of successful adaptation, because successful adaptations are often geographically and cultural specific, and socio-political and economic determinants creates an enormous diversity of situations. It is almost a truism: what works here may be totally inadequate there.

However, the scholarly narrative of experiences is where we must start. Significant comparisons, examples and analogues may emerge. These ideas must be compared to those emerging from an open dialogue with the communities directly at risk, particularly with the most vulnerable sectors. This dialogue may provide the affected communities and the researchers, with criteria that can illuminate the selection of appropriate strategies of adaptation. This requires an open-mind and receptive attitude from the part of the researchers to understand how people, their communities

and institutions make sense of the climate change-induced risks. The accomplishment of such a task is a value-driven exercise which does not preclude but rather requires the convergence of a scientific knowledge (subject to empirical verification by communities of peers) and a social constructivist approach which accounts for people's experience, perception and enacting of their lives - that is, their realities.

This paper is divided into the seven sections and one Appendix, as described below:

- **Section 2: The relevance of institutional adaptation** provides an explanation about the need to study and understand institutional adaptations.
- **Section 3: What are institutions? How can we operationalise the concept?** provides clarity about the definition and operationalisation of institutions.
- **Section 4: What is the institutional geography in Chile and Canada?** provides a description of the relevant formal institutional geography in both Chile and Canada and of their institutional dynamics.
- **Section 5: What is institutional adaptive capacity?** provides clarity to construct a working definition of institutional adaptive capacity.
- **Section 6: What are the components of this institutional capacity?** provides a detailed description about the components required for creating a successful structured institutional adaptive capacity, relating these components to three elements: inputs, processing, and outputs that are described to be later assessed during the evaluation of the adaptive capacities of public institutions.
- **Section 7: Institutional adaptive capacity and discourses** provides a discussion about how what is considered "successful" in institutional adaptive capacity depends a great deal upon the *main discourses* (value-frameworks, paradigms and models) articulated by the many and various constituents making up the climate change community. These discourses are argued to be important because they not only define the nature of the problem (what is to be asked) but also frame the possible solutions (what is to be done).
- **Appendix I:** provides a detailed description of institutions in Chile and in Canada.

2. The relevance of institutional adaptation

The fundamental issue about climate change is no longer whether climate will change. The question now is how we should respond. The strategy of mitigation has dominated the debate based on the argument that the threats of climate change could be avoided by internationally coordinated action by the countries of the world. The Kyoto agreement has been a central part of this strategy. There is an agreement, however, that mitigation will not stop climate change and accordingly, adaptation will be needed to cope with negative effects. In these terms, the almost certain failure of mitigation imposes new decisions and actions.

It is necessary and urgent to turn our attention, energies, and efforts to adaptation. Adaptation, up to this moment, has not been given the attention that it requires. Part of the reason for this lack of attention is the widespread belief that climate change is a gradual process and as such it is a long-term issue. This belief, however, could be an invitation to a disaster. Scientists have warned us that the process of climate change may be gradual only to a certain point, but after that point the changes could be unexpected and dramatic. In these terms, adaptation is not a task of the future, but in fact it is a necessity of the present that should be combined with mitigation in balanced global and national strategies (Wilbanks et al., 2003).

Several water-scarce regions are expected to be seriously impacted by climate change as a result of reduced steam flows and water recharge and increasing evapotranspiration that will have severe impacts upon crops, livestock, and local ecosystems (FAO, 2003: 371). The two selected basins by the project are good representatives of these vulnerable regions.

According to CCIAD (2002) the main impacts of climate change on Canadian prairie water resources, where the SSRB is located, are: "(1) changes in annual stream flow (possible large declines in the summer) with implications for urban and rural localities, agriculture, hydroelectric generation, ecosystems and water apportionment; (2) increased aridity and likelihood of severe drought with losses in agricultural production and changes in land use; and (3) increases in irrigation demand and water availability with uncertain impacts on groundwater, stream flow and water quality". Most of the scientific information points to actually increased rainfall and snowfall in the Prairie provinces… [yet] as a result of the higher temperatures, there will be a much greater loss of water by evaporation, and also plants will transpire more water. As a result of the increased water loss, the major impacts of climate change on the Prairie Provinces are loss of soil moisture and surface water. Even though the good news is a longer growing season, the major limitation, as a result of climate change, will be the loss of water. The "loss by evaporation, in particular, will much exceed the increased precipitation that is forecast" (SSCAF, 2003: 47-48). "In Canada, snow and ice are the principal source of runoff that supplies our surface bodies of water, such as lakes, rivers, and streams. Changes in snow accumulation in Canada's mountain ranges may not necessarily be gradual; indeed, there may be a "radical change" due to warmer winters. For the Prairies, the implications will be especially profound. Much of the water in Saskatchewan and Alberta is derived from glacier and snowmelt in the Rocky Mountains. This snowmelt is the basis for irrigation in southern Alberta and western Saskatchewan, and all of the cities in these two provinces derive their water either directly or indirectly from the Rocky Mountains. Yet, scientists expect "most of the glaciers in the Rocky Mountains to disappear this century" (SSCAF, 2003: 48). "As we see these wetlands drying up and disappearing on the Prairies, we will also see a loss of rare plant species. We will see a loss of habitat and of some of the shelter belts and willow rings around these systems. Therefore, we will lose habitat for species at risk, for species that use these places as watering holes and as protection from predators at various times in their life cycles " (Ducks Unlimited #20 in SSCAF, 2003: 49).

In the north of Chile climate change is showing its greatest impact in "the rate at which the Andean glaciers are melting". This has affected almost all aspects of life in the Coquimbo Region, where the Elqui River is located. Agriculture and mining, activities that place great demands on shrinking water supplies, are already suffering the consequences of this change and they will be hard hit under increasing changes in the climate. The *Primera Comunicacion Nacional* of the Chilean National Commission on the Environment predicts for the region significant decreases in precipitation and increases in temperature and aridity (CONAMA, 1999). Downing (1992), in his comparative study of vulnerability to climate change, reports that as a result of increasing temperatures and aridity there will be a reduction of wheat yields, reducing flowering quality and fertility of grape vines, increasing irrigation requirements, and more frequent and prolonged droughts.

The specific social impacts in the climate regions will be different in each basin, but a common denominator could be potential increases in water-use conflicts between sectors and within sectors regions and users. With increasing aridity, the future demand for water will increase (it is already increasing in Chile and Southern Alberta), so the existing water levels will not be able to meet that demand, and competition for water between sectors will increase. In the case of Chile, a recent report from the Universidad de Chile (Instituto de Asuntos Publicos, 2002) indicates a sevenfold increase in water demand by 2015. Chilean mining and the Canadian oil industry are

already increasing their demand for water to extract minerals and oil. The expansion of urban centers, such as Calgary in Alberta or La Serena in Chile, increases the pressures being placed on rural area water supplies. In the agricultural sector, farmers and ranchers are being pressured to increase production in a context where they face increasingly unpredictable supplies, and must increasingly compete with cities and other economic sectors for available water. A conflict within sectors – as it is the case of conflicts that emerge around irrigation—could only increase.

In this context the need for increasing the adaptive capacities of the two regions is fundamental. There is no doubt that developments in technology and infrastructure, as well as the availability of economic resources, will be essential to improve water use efficiency. These capacities, however, are not enough. As FAO argues, "institutional changes are going to be as important as or more important than technological ones" (2003: 372). These institutional changes involve the development and implementation of comprehensive support mechanisms that improve the capacity of different sectors to adapt to climate change. As O'Riordan (1997: 2) argues:

> Institutions help to define climate change both as a problem and a context, through socialized devices as scientific knowledge, culturally defined interpretation and politically tolerable adaptation policies. There is, in short, no 'climate change' outside of a socially constructed framework.

Of paramount importance is the development of adaptive mechanisms in those human settings that are the most vulnerable to climate variability and change –such as rural communities and rural households. They involve the strengthening of capacities such as human and social capital, access to information, availability and access to resources. In addition, and not less important, is the existence of institutional actions at the level of the state and the civil society that could contribute to the development of the internal mechanisms of communities and households. Although not so overtly exposed to the most direct effects of climate change, those formal institutions are key actors who mobilize significant resources and what they do or do not do impinge directly on human communities and ecosystems, which are directly exposed and to varied degrees, vulnerable. These actions involve not only disaster preparedness planning or the introduction of new crops, but also the capacity to identify problems created by climate change, seek solutions to them, and implement those solutions in a fair, efficient and sustainable manner. This paper proposes an approach to investigate the capacities of these public and private institutions to facilitate the process of adaptation to climate change and to reduce water impacts and their consequences.

3. What are institutions? How can we operationalise the concept?

Before proceeding to the task of discussing the capacities of these institutions, it is necessary to discuss the issue of how the term "institution" should be conceptualized and operationalised in this project.

Institution, as used in the social sciences, is a strikingly diffuse concept due to its high level of abstraction. As such it is a term that "is contested with respect to both definition and interpretations" (Smit et al. 2005). It refers to all those means that hold society –or the different component of society—together. Buttel, for example, defines institutions as "specific or special clusters of norms and relationships that channel behavior so as to meet some human, physical, psychological, or social need such as consumption, governance and protection, primordial bonding and human meaning, human faith, and socialization and learning" (1997: 40) (in this definition then, institutions and society are the same thing). Similarly, in Homer-Dixon (1999, 213) adopts the idea of institutions as "the rules of the game in a society or, more formally, (as)

the humanly devised constraints that shape human interaction". Institutions are defined as "stable and predictable arrangements" for the coordination of human interaction (Ferrante, 2003: 5); as "social practices" that involve power and authority (Ishwaran, 1986: 247); or as "sets of norms, values, and beliefs, developed to resolve" recurring social problems (Hagedorn, 1994: 367). All these definitions are as vague as the notion of society or culture, making them not very useful or practical.

These different emphases allow the understanding of institutions as both "structures of power and their resulting organizational forms, and to socialized ways of looking at the world as shaped by communication" (Jordan and O'Riordan: 1999: 4), ranging from organizations to hegemonic discourses, from highly formalized settings to informal arrangements. In this way, it is not a surprise then that the term "institution" has been shaped and explained from a variety of perspectives, each one of them with a different explanation of the logic that motivate institutions, their origins, changes, their relationships to history, level of analysis, and their relationships to individuals. (Jordan and O'Riordan (1999) provide an interesting summary of the different approaches in pages 12-18). There is however a basic agreement about the nature of institutions: they involve rules -- which define roles and procedures for people; have a degree of permanency and are relatively stable; they determine what is appropriate, legitimate and proper; and are cognitive and normative structures which define perceptions and interpretations (O'Riordan and Jager: 68). Thus, we could define institution as --drawing partly on Henningham, 1995) -- a persistent, reasonably predictable arrangement, law, process, custom or organization structuring aspects of the political, social, cultural or economic transactions and relationships in a society. Institutions allow organized and collective efforts towards common concerns and the achievement of social goals. Although by definition, persistent institutions constantly evolve.

The World Bank, with a more pragmatic approach, defines institutions as "the rules, organizations, and social norms that facilitate coordination of human action". The important advantage of this definition is that it is less abstract, including "organizations" as part of the definition and facilitating the operationalisation of the term "institution" for the implementation of the proposal. A similar argument is found in Newman, who defines organizations as "stable sets of statuses, roles, groups, and organizations that provide the foundation for behavior in certain major areas of life" (302). Thus, organizations link people and major social institutions.

Following the critical realism of Danermark et al. (2002), an argument could be made that institutions and organizations exist at different levels of reality, an organization being a more concrete representation of an institution. Thus, an institution is an underlying, durable pattern of rules and behaviors, and an organization is the changeable manifestation of that. For example, the institution of the common law in Canada or the civil law in Chile manifest through the organization form of a particular court system. In these terms, and in order to understand the empirical presence of the term "institutional adaptive capacity", it is valid to assume that organizations are surrogates or stand-ins of institutions; they are institutional actors that embody the nature and processes of specific institutions. We will do this with the important proviso that an organization would need a good degree of longevity and social acceptance to be thought of in these terms.

In is important to clarify that organizations are not the only institutionalized settings that exist in society. Institutions could also take the form of less formal settings, where there are no organizational structures and specific purposes attached (Haas et al. 1993, 5). Communities and households are a good example of informal settings, which in spite of not having the highly formalized nature of bureaucratic organizations they have the capacity to define the parameters of the behavior of their members and the nature of their relationships. Communities and households

are not just groups of people living in the same area or under the same roof, but they are also symbols, discourses, norms, all those understandings that make organized everyday life possible. They have informal rules, they have a certain degree of stability, they help frame the perceptions of their members, and they define what is right or wrong.

To recapitulate, our project is a study of institutions to the extent that it seeks to understand the adaptive capacities of *some* informal institutional actors –rural communities and rural households— and the roles played by formal institutional actors –public and private organizations—in the development of those capacities. Public and private institutional actors, in the perspective of our research, have a paramount importance given the role that they play in management of resources such as water. It is people and the ecosystems in which they live, in their local informal institutional settings, who are the ones who face climate-related problems but they are highly dependent on public and private institutions in dealing with those problems. Rural communities and rural households, like many other human settings, functions within institutional systems that link those settings with the larger society. These institutional systems pervade the lives of the community members by imposing a body of regulations, rules, processes, and resources that may either support or conflict with the capacities of those communities and households. This imposition is carried out by organizational structures, or institutional actors, whose existence is governed and legitimized by institutions (see Alcorn and Toledo, 2000: 218).

It is important to recognize the linkages between the informal institutional settings and the formal institutional actors. But it is also important to recognize the differences between them. Dorothea Hilhorst, in an article about disaster response (2004), talks about social domains in a perspective that is very similar to our approach based on formal and informal institutions. She makes a distinction between the domain of local responses and the domain of disaster governance, defining them as areas of social life organized around specific norms, rules, and values. These domains interact with each other, but they are also internally characterized by different experiences, ongoing processes of negotiation and conflicts, and different discourses about nature. So, these domains are differentiated and complex realities that require to be understood in terms of their relationships to each other and in terms of their own dynamics.

Finally, it is also relevant to recognize that both informal and formal institutional actors exist in larger contexts, which impose their own dynamics upon the ways in which households, communities, and formal institutions operate. Thus, an assessment of institutional adaptive capacities must pay attention not only to the capabilities of these formal and informal institutional actors, but also recognize those national institutional dynamics that influence and shape the organization, operation, and functions of the institutional actors. These institutional dynamics emerge from the activities and decision making processes of formal organizations, but once they are adopted they have the capacity to impose themselves upon the formal and informal institutions.

In these terms, what is the institutional geography that constitutes the field of action for the project? The next section provides a description of the relevant formal institutional actors and institutional dynamics that exist in each country.

4. What is the institutional geography in Chile and Canada?

The institutional geography of both countries replicates their physical geography. In both cases is complex and varied. There are certain aspects of these two institutional geographies that are similar, but there are also significant differences. This section describes the main dynamics that affect the organization and functions of public and private institutions operating in the area of

water management and water use (a detailed description of the Chilean institutions responsible for water and their functions is provided in **Appendix I**).

A. The Case of Chile

Chilean institutions operate in the context of three main institutional dynamics. These dynamics are the free market as the main economic organizational mechanism, a judicial system based on the Roman law, and a process of administrative decentralization that seeks to transfer administrative responsibilities to regions and municipal governments. The first two dynamics have a direct implication for the use of water resources, while the last plays a central role in the ways in which public institutions operate.

(i) The Free Market

The neo-liberal economic principle of the free market has been central to the Chilean strategy of development since the mid-1970s. Following the coup d'etat of 1973 Chile became the first Latin American country to adopt and pursue a model of market liberalization and opening to the international economy. This model led to a radical opening to external trade, attraction of foreign capital, and the liberalization of domestic prices, union laws, and the financial system. In addition, the military regime implemented a series of measures directed toward the privatization of the public sector production and services, including partial abandonment of the state's regulatory and welfare function established from the 1930s and increased during the government of Allende (1970-1973). This was a process that sustained political democracy based on of the consensus around the Industrialization by Import Substitution, a consensus that breaks down during the late 1960s and beginning of the 1970s. The military regime's main task is to open the country up to unrestrained trade liberalization and to set in motion a new project of development open to foreign investment and internationalization of the Chilean economy.

The democratic governments that replaced the military regime did not fully challenge the hegemony of neo-liberalism. While the democratic governments have clearly indicated that they are not neo-liberals, they have embraced some clear neo-liberal ideas and economic principles, such as the free market, international trade liberalization, specialization of comparative advantages and the private sector as the "engines" of development. By the time democracy came back to Chile at the end of the 1980s, Chile was already deeply entangled in the web of free-trade. However, this commitment to neo-liberalism has followed a less radical approach to the extent that the democratic governments have adopted a more active role in regulating business and the markets, as well as in terms of insuring a welfare minimum.

The free market doctrine has impacted the management of water resources in two areas: water resource allocation and the capacity to resolve conflicts around water issues. Water allocation has become a market issue, allowing the existence of private water rights and their free transaction in the market. As Bauer indicates, the Chilean model of the water market is different than the market model followed by other countries. Rather than using the market as a policy instrument, Chile has subordinated water management to the market. This has reduced the capacity of public institutions to manage water resources and, especially, their capacity to provide rules and conditions for the resolution of water conflicts (see Bauer, 2004; Galaz, 2003).

The Chilean water market was developed by the military regime with the purpose of promoting increasing economic efficiency by allocating water resources to their most valuable uses. The Water Code dictated in 1981 was in that sense, a turning point. In spite that the Chilean water market has been presented as an example of efficiency in dealing with water resources, however,

very few studies have been done about the impact of the market upon those resources and the different water users (for an analysis of the existing research see Bauer, 2004). One of the few comprehensive analyses has been done by Galaz (2003) who confirmed earlier findings of a study published by the Economic Commission for Latin America (ECLA) focused on the functioning of water markets (Dourojeanni & Jouravlev: 1999). These studies identified three main positive impacts of the market: (i) an increase on investments in the improvement of water infrastructure; (ii) the leasing of water rights in period of droughts; and (iii) a more efficient transfer of water rights from agriculture to urban water companies. On the other side the studies showed that the existence of the markets has had also significant negative impacts such as the speculation of water rights and water rights violations, affecting mainly small agricultural producers (see also Sabatini and Sepulveda, 1997). This is the situation that finally led to the reform of the Water Code in March 2005, after 13 years of entanglement in the two branches of the Chilean National Congress, described later in this paper.

(ii) The Legal Setting

Chile's basic legal framework is characterized by a Roman legal system. The legislative and executive branches of the government create the laws and the judicial branch's role is to apply and enforce the laws. Thus, the judicial branch is subordinate to others and judicial decisions do not create binding precedents, as in the case of Canada.

The access and use of water resources are defined in this legal context. Existing Chilean water laws are embodied in a water code that has had significant historical changes since 1855 (see Mentor, 2002). The 1981 water code (transformed now in March 2005) was enacted by the military regime. It replaced the 1967 water code, which provided the state with a significant amount of authority upon water rights as a way to support a massive redistribution of the agricultural land that was taken place at that moment. The 1981 water code was oriented to promote private agricultural development and economic efficiency through a water market, reflecting the process of liberalization of the economy pursued by the military regime in the context of a dismantling of the Agrarian Reform and a type of modernization of agriculture aiming at making the country's rural sector a platform for exports based on the "comparative advantages" of Chilean fruits and wine.

This water code has sought to increase the legal security of private water rights, separating them from land ownership. Water resources were still defined as public property, but the state could grant private rights to use. Once water rights were granted, they were fully protected as private property rights under the Chilean constitution and they could be freely sold, bought, transferred, or inherited as any tradable commodity. (see Bauer, 1988, Mentor, 2001 and Dourojeanni & Jouravlevi,1999). The fact that water rights have constitutional protection meant that they could not be appropriated by the state without specific legislation and compensation.

Under this legal framework for water resource allocation, private rights were extensive and state authority and control were constrained. Those who owned water rights were not required to indicate how they would use their water resources, neither could they loose them as a result of nonuse. Moreover, owners of water rights did not have to pay taxes or fees to the government. This unconditional nature of the water rights allowed for unregulated speculation in water rights and, in some other cases, for hoarding of these rights (Bauer, 1988, and Dourojeanni & Jouravlev, 1999). It is also important to mention that most of the water rights were not formally registered. They predated 1981 and they were recognized as traditional rights, with the same constitutional protection for the rights awarded after that year.

As Bauer (2004) argues, the 1981 water code was oriented mainly to ensure irrigation rights and it did not deal specifically with water uses and how to coordinate them. The law did not establish any priorities in terms of the use of the resources following the precept that this function competes to the market. This meant that disagreements about water use and coordination were left to the market, where private bargaining among owners of water rights played a central role. When this bargaining fails the only alternative left to resolve existing conflicts and differences are the civil courts. This alternative, however, is not viable for small agricultural producers who have had their water rights violated given the costly and slowly judicial procedures (Galaz, 2003; Sabatini and Sepulveda, 1997). In the context of the Elqui Valley this translated into further hegemony of the large producers for exports: wine, grapes and lately, avocado.

According to the cited ECLA study (Dourojeanni, Axel & Jouravlev, Andrei ,1999), the system of water rights established by the 1981 Water Code was strongly biased in favor of the protection of property rights over water licenses, which due to the form of allocation of those rights, made the licenses for all practical purposes, equivalent to a right for property of water. These effects were reinforced by Article 24 of the Chilean Constitution that declares that: "The rights to water given to privates, recognized by or constituted according to the law, will provide their holders the property over those rights". This is a unique case in the region where there is specific mentioning of water property rights in the text of the Constitution. Not surprisingly, this passage of the Constitution created by the military regime has become a central argument used by the opposition to reforms to the Water Code.

After 13 years of debate and paralysis within the two branches of the Chilean Congress, --seven years in the Chamber of Deputies and five in the Senate-- a bill containing a number of important reforms to the Chilean Code of Water has been finally approved. The main aspect of the reform is the establishment of fees to be paid for not using previously acquired water rights, particularly "non consumptive rights", that is, those rights which are not used for water consumption but for other ends, such as the production of electricity and those that return water to its original source. Until the approval of the reform of the Water Code, these water rights could be requested to the state who would freely grant them, unless there were other parties requesting them, in which case an auction would take place. Water rights thus acquired became an asset that could be freely exchanged (bought and sold) among interested parties.

The March 2005 main changes to the 1981 Water Code establish a number of pre-requisites for the allocation of water rights. It is important to keep in mind that until the approval of the reforms and unlike in any other country, water rights were freely allocated, in perpetuity and without flows limitation. The implication of this policy has been that few private entities can concentrate large amounts of water rights without using them, depriving others from the possibility of using them in specific projects. According to Aguamarket (2005) there are examples of allocation of non-consumptive water rights for up to 13,000 cubic meters per second of which only 2,500 cubic meters per second have been used. The same source cites examples of applications for non-consumptive water rights for 50.000 cubic meters per second, a volume of flowing water equivalent to five times the flowing volume of all Chilean rivers from Arica to Puerto Montt (Aguamarket, 2005 www.aguamarket.com/noticias/131.asp)

The reforms to the Water Code now require that applicants to water rights provide a justification of water flows to be used in economic activities to be carried out, and the Direccion General de Aguas (General Direction of Water) of the Ministry of Public Works will have the power to deny the allocation of unjustified water rights applications. Also, water right holders will have to pay fees for not using acquired water rights, to provide disincentives for the speculation and concentration of control of water rights. These fees will be in place from January 2006 for most

regions, and will be charged whenever the holder of water rights fail to demonstrate the ability to capture water, according to a charter specifying appropriate water volumes for the different climatic zones of the country.

Another feature of the reforms to the Water Code will be in the refinement of the system for auctions used to allocate water rights whenever there is more than one applicant, making the process more open, with the aim of making the access to water rights more competitive to optimize water usages. The new law establishes mechanisms to monitor water rights and exchanges among water users. It establishes the concept of ecologically sensitive water flows ("caudales ecologicos"), which if properly specified would strengthen the protection of ecologically sensitive watersheds, permitting in some cases the expropriation of water rights already conceded to private users in rivers showing a severe decline in water flows.

Another significant novelty is the provision of new regulatory capacity and enforcing muscle to the General Direction of Water to address critical events such as droughts, illegal appropriation of flowing waters and underground waters, and to arrest unauthorized development works. The law establishes also clear timelines for the regularization of water rights for well waters so far unregistered by small agricultural producers.

The historical evolution of the Chilean Water Code and the reforms introduced to it are significant because they establish policy environments that can enable and enhance, or conversely, jeopardize the adaptive capacity of institutions. This is particularly important for a research project that focuses on specific regions where climate change-induced water scarcities are rapidly unfolding, placing heavy demands on water relevant institutions. National given policy environments, shaped by contrasting values and ideological discourses can significantly impinge on the adaptive capacity of regional and local institutions, and completely re-shape the dynamic between public and private institutions who are important stakeholders in water issues. The new Water Code will provide a new arena for the political confrontations, negotiations and alliances around water issues. For example, the organizations of the environmental movement have reacted positively vis a vis the new legislation, seeing it as an opportunity to improve distributive justice and environmental protection of sensitive watersheds (Chile Sustentable: 2005)

On the other hand, prominent think tanks associated with the neo-liberal discourse of the political right, like the Instituto Libertad y Desarrollo have voiced their opposition to a legislation they perceived as negatively affecting property rights (Libertad y Desarrollo, 2005)). These opposing discourses and the debates that preceded and followed the reforms to the Water Code are powerful indications that water conflicts under situations of scarcity will intensify, placing new demands on institutions such as the General Direction of Water and its associated networks, to develop adaptive conflict resolution approaches aiming at the sustainability of water. (Please note: A forthcoming companion paper will examine in-depth the role of the new legislation in water conflicts and the ways it affects institutional adaptations to climate change-induced water scarcities).

(iii) The Process of Decentralization

Chile has been historically characterized by the existence of a centralist institutional system that has its origins in the early administrative and institutional organization of the country, which took place immediately after the war of independence. The XIX century needed to consolidate the organization of a state-nation by subordinating the regional interests to the national goals

produced a highly centralized country. This need took the form of a presidential regime characterized by a high level of authority that concentrated the public decision making process in the central government established in Santiago.

By the 1960's it was clear that a highly centralized system was problematic for the development of Chile. It allowed for the constant marginalization of large areas of the country and the expansion of the economic and political power of Santiago. The initial efforts to decentralize the country started in the 1960s, under the governments of Frei and Allende. The process of decentralization had a significant development under the military regime, which initiated the administrative reorganization of the state, established the existing administrative regions, and created programs and incentives for the development of specific regions aimed at facilitating privatization, not to enhance democracy.

Under the democratic governments that followed the military regime, the process of decentralization has been considered a fundamental component of the modernization of the state. It replaced the centrally appointed municipal governments by democratically elected ones. An increasing role of regions and local government has been defined as a necessary condition for increasing the public agencies' levels of efficiency, technical capacities, and institutional responses to the challenges of globalization. In this perspective, the democratic governments have fostered a variety of measures oriented to reinforce the capacities of regional and local governments.

Paradoxically, the process of decentralization, however, is still characterized by a high level of centralism. In spite of the political efforts to provide regions with the resources and capacities to decide their own regional development the political decision-making process and economic development are still centralized in the Metropolitan Region. Regional officers are still chosen by the President of Chile, local governments, although democratically elected, still have limited resources and capacities, and the Ministry of Finance still rigidly decides about the distribution of financial resources. The public institutional system in Chile is still characterized by a high centrality of decisions, with a central office and regional administrative secretariats that implement the decisions of Santiago. The consequences are clear. According to the Programa Chile Sustentable, only 10% of the decisions regarding public spending are taken in the regions. The rest, 90%, are taken by the central agencies in Santiago. The economic weight of Santiago is still predominant. It has only 39% of the national population, but it consumes almost two thirds of what is consumed in Chile (2003: 122). This limited process of decentralization seems to be a significant challenge for the development of proper institutional adaptive capacities of the different levels of the Chilean government.

B. The case of Canada

The institutional dynamics surrounding water management in Canada include (i) political decentralization, (ii) an emphasis on sustainable development, and (iii) a governance approach to water management.

(i) Political Decentralization

The Canadian public institutional system is organized around a federal structure, composed by a central government, provincial governments, and local or municipal governments. In these political structures, different levels of government have different functions and responsibilities and some degree of autonomy. This political arrangement is a sharp contrast to the centralized

institutional system that characterizes Chile, imposing its own dynamics upon the functioning of public institutions and their capacity to deal with the demands and challenges of the civil society.

The management of natural resources in Canada is formally a government responsibility. The Constitution requires that responsibilities for the management of resources (including water) are shared between the federal government and provincial governments. In this sense, the power of the federal government is somewhat limited in those areas where the provincial or local governments have control over the decision making process. Although the management of resources is politically decentralized in most cases, the federal government has the power to intervene if necessary (Dwivedi et al., 2001).

The federal government did not have official legislative authority over resources and environment until 1971. That year, the Department of Environment (now Environment Canada) was formed in response to pressure to protect the environment and control pollution. Within a few years after the federal government created the Department of Environment, all of the provincial governments created their own departments or ministries of environment (Dwivedi et al., 2001). As a result of this multi-layered public institutional structure, there is a strong need for cooperation between the different levels of government in all aspects. As Dwivedi et al. (2001) explain: "federal-provincial coordination has become a vital and necessary part of the governmental response to environmental problems and, for the most part, there has been a high degree of cooperation between Ottawa and the provinces in devising solutions to these problems" (p.69).

In this political context, the institutional framework for water management in Canada is also decentralized. There are institutions at all levels that deal with water issues. Federal, provincial, municipal and community institutions all have impacts on water management. The federal government provides legislative guidelines and a general framework for sustainable water management. The provincial governments are responsible for inspection and infrastructure (McKenzie, 2002). Municipalities are responsible for their own water systems. The federal government has the capacity to provide rules and conditions for the resolution of water conflicts among governments and users. The federal government can intervene at any level if there are disagreements about water use and coordination, but every effort is made to prevent disagreement and conflict.

The management of water in Canada is clearly an issue of governance and not a result of market conditions, as in the Chilean case. In these terms, the concept of government guidelines, standards, and regulations in Canada presumes some degree of protection of water as a public good, but this works only insofar as guidelines are acted upon in the best interest of society. If complacency or in action set in, negative consequences may result.

Historically water has been taken for granted and undervalued in Canada. Early water management practices were based on the mistaken assumption that water supply was unlimited. Even today the prices charged for water in Canada are among the lowest in the world. Price is not always related to the volume of water consumed, and often the price charged for water is below cost. In these terms, it is not strange that Canadians consume more water per capita than any other country, except for the United States (McKenzie, 2002). In a country with 9% of the world's renewable water supply, and less than 1% of the world's population, the sustainable management of water is very important. As the importance of sustainability has been realized, water management practices and policies have been reoriented.

(ii) Sustainable Development Approach to Water Management

During the 1990s, the federal government and many provinces reoriented and restructured their approaches to water management to meet the needs of sustainable development and an ecosystem approach (approaches that unfortunately have not always been implemented effectively) in a period of significant financial constraint. Several aspects have emerged as important in the reorientation and restructuring of water management, such as water policy, an ecosystem approach, groundwater management, partnerships and stakeholders, First Nations, water pricing, and water export (Mitchell & Shrubsole, 1994).

Many governments have developed comprehensive water policies for their jurisdictions. These policies recognize that water is one component of a larger ecosystem, and, accordingly, linked to other environmental resources and the economy. Governments have recognized the importance of planning, managing and developing water resources in the context of ecosystems that cover both terrestrial and aquatic resources. Although there is agreement about the need for an ecosystem approach, there is no common approach to foster it (Mitchell & Shrubsole, 1994). Many people and most government agencies have been promoting watershed management as the best strategy to manage a sustainable approach to water management, a strategy that promotes the joint management of a watershed by the stakeholders. The existence of a federal/provincial system has been however a challenge for the implementation of watershed management due to the imposition of political boundaries and the co-existence of a multitude of agencies that makes coordination a complex issue. Increased attention to groundwater management is another aspect that has become relevant among public agencies in the public approach to sustainable water management. This involves paying more attention to possible contamination sources and adjusting land use practices as necessary.

Water management often involves partnership arrangements that regionalize responsibilities for water, making local governments or NGOs responsible for water management. Partnerships between federal and provincial governments and First Nations have emerged to deal with aboriginal and treaty rights and jurisdiction over natural resources, while recognizing, accommodating, and protecting the interests and use of waters by First Nations. Governments are also moving toward demand management strategies (rather than supply based strategies). These strategies often involve incorporating user pay and full cost pricing of water resources, as well as conservation and water treatment.

Canadian water is generally treated as a public good, but some want water to be treated as a tradable market commodity. As a result, there is controversy over the sale of Canadian water as free market commodity. Canadian fresh water is sold in the form of bottled spring water and as bulk water exports. A number of environmental groups and provinces are working to ban water exports permanently (McKenzie, 2002). Some groups argue that Canada should sell water on the market like any other commodity, while others warn that the sale of bulk water under NAFTA leaves Canadian waters and measures designed to protect them vulnerable to foreign investor claims (McKenzie, 2002). The Federal Water Policy commits the federal government to take measures to "prohibit the export of Canadian water by inter-basin diversion," but Canada still needs to develop a national water export policy.

Canada has developed a number of non-legal guidelines and policies to govern water management; however, as they are non-legal, no one is legally bound to follow them. Although governments have done well at creating guidelines and policies for water management, they have not done so well at implementing and enforcing them. The water contaminations that occurred in Walkerton, Ontario and North Battleford, Saskatchewan reflect some of the problems around implementing and enforcing water management practices in Canada.

In May of 2000, the drinking water system for Walkerton, Ontario became contaminated with E. coli. As a result of the contamination, 7 people died, over 2300 people became ill, and some people may endure lasting effects (O'Connor, 2002). The source of the contamination was manure that had been spread on a farm near one of the town's wells. According to the report on the Walkerton inquiry (which was conducted to determine what happened, who was responsible, how to prevent it from happening again, etc.), the outbreak could have been prevented (O'Connor, 2002). Specifically, the use of continuous chlorine residual and turbidity monitors at the affected well could have prevented the outbreak. According to the report, "The failure to use continuous monitors …resulted from short-comings in the approvals and inspections programs of the Ministry of the Environment (MOE). The Walkerton Public Utilities Commission (PUC) operators lacked the training and experience necessary to identify either the vulnerability of Well 5 to surface contamination or the resulting need for continuous chlorine residual and turbidity monitors" (O'Connor, 2002: 3).

In April, 2001, the protozoan parasite "cryptosporidium parvum" was detected in the drinking water system for North Battleford (North Battleford is a city of approximately 15,000, located on the North Saskatchewan River). The parasite entered the water system through the surface area treatment plant that draws raw water from the North Saskatchewan River. Six to seven thousand people became ill after drinking the water. The inquiry into the North Battleford incident found that "accepted industry standards and practices for the treatment of surface water are far more specific and demanding than what was specifically identified in government regulations and guidelines, or in North Battleford's permit to operate a surface water treatment plant" (Laing, 2002: 5).

As a result, virtually all Canadian provinces have reacted to these two incidents, and many federal and provincial departments have reviewed and or modified their roles related to aspects of water management.

(iii) The Governance of Water

As a result of the decentralized structure of the public institutional system it has been necessary to establish specific areas of responsibilities for a variety of public institutions that exist at the different levels of government. The definition of water as a "public good" requires a proper governance of water resources, where cooperation, communications and resources sharing are basic pre-requisites.

Water management responsibilities at the national level are shared between Environment Canada and the provincial governments. Environment Canada controls navigation and fisheries, as well as water on federal lands and on the reserves of Canada's First Nations people. In addition, there are a number of responsibilities that are shared between the federal government and provincial governments, including: inter-provincial water issues, agriculture, significant national water issues and health.

The Canadian federal government conducts research and provides guidelines and regulations for water management. The federal government is also responsible for legislation. The federal legislation that deals with Canadian water is the Canada Water Act. The Canada Water Act is "an act to provide for the management of the water resources of Canada, including research and the planning and implementation of programs relating to the conservation, development and utilization of water resources" (Canada Water Act, Ch. C-11). The Canada Water Act calls for joint consultation between the federal and provincial governments in matters relating to water resources. Joint projects involve the regulation, apportionment, monitoring or surveying of water

resources, and the pre-planning, planning or implementation of sustainable water resource programs.

Agreements for specific water programs arrange for the participating governments to contribute funding, information and expertise in agreed ratios. For ongoing activities such as the water quantity survey agreements with each province, cost-sharing is in accordance with each party's need for the data. For study and planning agreements, it is usual for the federal government to meet half the costs and provincial government(s) the other half. The planning studies encompass inter-provincial, international or other basins where federal interests are important. Implementation of planning recommendations occurs on a federal, provincial, and federal-provincial basis. Cost-sharing of the construction of works often includes a contribution from local governments.

While providing national leadership to ensure that Canada's freshwater management is in the national interest, Environment Canada also actively promotes a partnership approach among the various levels of government and private sector interests that contribute to and benefit from the wise management and sustainable use of the resource (http://www.ec.gc.ca/).

The division of responsibilities for water is complex and often shared. Under The Constitution Act, provinces have the primary responsibility for the management of their water resources, which includes both surface and groundwater. The provinces are responsible for flow regulation and authorization of water use development, and they have the authority to legislate areas of water supply, pollution control, and thermal and hydroelectric power development.

Provincial governments often enter into arrangements with the federal government in order to establish intergovernmental committees or other bodies to advise on the formation of water policies and programs, to maintain continuing consultation on water issues and research priorities, and to facilitate the coordination and implementation of water policies and programs.

Water is a considered to be a provincial resource, but water often crosses political boundaries. Most of the rivers in the Canadian prairies flow from west to east, crossing from one province into another. Runoff from the eastern slopes of the Rocky Mountains is the major water supply for the large southern rivers of the Prairie Provinces. These rivers flow eastward across Alberta, Saskatchewan and Manitoba to empty into Hudson Bay. The ownership of the waters of a river system flowing through several jurisdictions can give rise to many administrative and water use problems.

Saskatchewan, Alberta, Manitoba and Canada formed the Prairie Provinces Water Board (PPWB) in 1948 to recommend the best use of inter-provincial water, and recommend water allocations between the provinces. This method worked well until the 1960s, when the provinces began requesting large allocations of water. Since the approach used by the Board was no longer adequate to allow long-term water planning by the provinces, a new system for sharing this limited resource was developed. In 1969, the parties to the original agreement signed the Master Agreement on Apportionment, which continues to guide board activities to this day. This document contains a simple formula based on the principle of equal sharing of available water in the prairies. The formula states that Alberta and Saskatchewan may each take up to one half of the natural flow of water originating within its boundaries and one half of the flow entering the province. The remainder is left to flow into Manitoba. The Master Agreement also established the Prairie Provinces Water Board to oversee the Agreement.

The mandate of the Prairie Provinces Water Board is to ensure that eastward flowing inter-provincial streams are, in accordance with the provisions of that Agreement, shared equitably, that water quality at inter-provincial boundaries is maintained at acceptable levels, and to facilitate a cooperative approach for the integrated development and management of inter-provincial streams and aquifers to ensure their sustainability.

The provincial and federal governments set guidelines and regulations for water management and there are several government institutions with responsibility for water issues, but active day-to-day management of water is often undertaken by smaller local institutions. Stakeholders and residents often organize to manage and protect local water resources. Civil society institutions tend to develop in river basins, in areas dominated by irrigated agriculture, in drought prone areas, and in areas that are dependent on groundwater (i.e. Partners for the Saskatchewan River Basin, the Bow River Basin Council, and the Swift Current Creek Watershed Stewards). According to the Canada Water Act, the federal government can only intervene (i.e. directly undertake the formation and implementation of a water resource management plan) if efforts to establish an agreement with the provincial government(s) have failed, and there is a significant national interest in the water resource management of the water(s) in question.

5. What is institutional adaptive capacity?

What is adaptive capacity in the case of public institutions? Public institutions are not directly exposed to the vicissitudes of climate, as it would be the case of an agricultural community that is dependent on a given range of climate patterns. Thus, the adaptive capacity of a public institution should not be understood as an ability to reduce its own exposure to climate but rather as the ability to perform functions that facilitate the adaptive capacity of their constituencies. Willems, in his discussion of "institutional capacity" and climate policy, grasps very well the nature of institutional capacity, arguing it is the "ability (of a certain country) to mobilize and/or adapt its institutions to address a policy issue, as climate change" (2004, 8).

A successful institutional adaptive capacity is clearly related to the ability of organizations to mobilize resources and to concentrate human capital in areas that are relevant to climate policy. In these terms, the argument that developing countries with limited resources could have a limited adaptive capacity is valid. What is problematic is the simplistic inference that given that countries like Canada have access to resources, then adaptation in developed countries should be a relatively simple task. This inference is problematic because it simplifies what adaptive capacity is and overestimates the adaptive capacities of industrialized countries.

There are many examples that demonstrate that developed countries do not always have the capacity to deal properly with environmental change. A case in point is the Canadian approach to BSE, Bovine Spongiform Encephalopathy or Mad Cow Disease. In spite of the constant reassurances from government agencies and the cattle industry that BSE is under control, and after billions spent in dealing with the problem, it still threatens our existence. There is no doubt that government agencies and industry have failed to monitor the disease and control its spread. Under this light, could we assume that industrialized countries have to capabilities to deal properly with the risks created by climate change, a more serious and complex threat than BSE?

Adaptive capacity is an ability that requires access to resources, but this is not sufficient. It is also more than a straightforward technical issue. The development and implementation of technological measures by public institutions could be an important contribution to reduce the vulnerability of different social groups. Adger (2003: 30) reminds us, however, that these technological solutions could be problematic. They tend to have a socially differentiated impact,

benefiting some sectors of society to the expenses of others; a factor that could multiple the negative consequences of climate change, producing "double losers" and "double winners". Second, their contribution to adaptation to climate variability within the existing coping range could be high, but this range may change in a radical way under the new ranges created by climate change.

It is helpful to keep in mind that climate change is not a simple crisis of the environment; it is a crisis of sustainability. It could seriously impact upon the availability of resources, the viability of human settings, the livelihood of sectors of the population, and, in the long term, the social processes that characterize the relationships between the civil society and the state. In these terms, climate change could take us in a path that promotes unsustainable development. In this perspective, we should think of adaptive capacity as a complex challenge that requires a collective effort. What we need to do is to increase the adaptive capacity of society by combining a multiplicity of factors that already exist in the economy, the state, the civil society, and culture. Such factors involve technology, assets, capital resources, human and social capital, scientific knowledge, and institutional capacities, such as effective social networks and flexible and innovative organizations. This multiplicity of adaptive factors should be organized in a cohesive and coherent manner, where these factors interlock with one another in such a way that together increase the adaptive capacities of our society. In other words, what we need is not a myriad of unrelated adaptive measures but a *structured* adaptive capacity.

In this context, public institutions must have the necessary degree of flexibility to deal with the unexpected conditions that we should expect from climate change's impacts. Their role is the implementation of an enabling environment that makes possible the strengthening of civil society to successfully deal with the challenges of climate change. As Smit and Pilifosova (2003: 22) argue "…adaptation is less about identifying and implementing specific climate change adaptation measures and more about strengthening an ongoing process where resources are available to identify vulnerabilities and employ adaptive strategies." Adaptive capacity, to be successful, must be able to identify and resolve people's problems and to grasp and satisfy people's needs in a fair, efficient and sustainable manner. In these terms, the adaptive capacity of public institutions is related to their ability to anticipate problems, to manage risk and challenges in a way that balance social, economic, and natural interests.

6. What are the components of this institutional capacity?

The adaptive capacity of public institutions involves their increasing and constant attention to the problems of the different sectors of civil society in the context of climate change, as well as the predisposition to resolve the problems in a way that is satisfactory to the different sectors of the civil society. In these terms, we could argue that the components of this institutional capacity are related to the openness of the political system to identify problems and issues in the civil society --the input side--; the ability to seek solutions to those problems –the processing side--, and the capacity of the political systems to implement solutions --the output side. The vulnerability assessments of rural communities will provide us with, first, some basic information of how rural people evaluate the performance of the institutions in these three areas; and second, a sense of the degree of legitimacy of these institutions –the predisposition of people to accept the validity of these institutions in terms of reducing their vulnerabilities. This is an important starting point, but our evaluation of the institutional capacity – the next stage after the vulnerability assessment of the communities - must go beyond this initial point. In order to do this, we must have clarity about the components of the institutional capacity

This is not a Herculean task. There are already several works that describe the capacities that institutions require to deal with challenges such as resource scarcities (Homer-Dixon, 1999) and the challenges of sustainable development (World Bank, 2003, Goodin, 1996; and UNEP, 2002). These works identify most of the components that should be assessed during the evaluation of the adaptive capacities of public institutions.

The Input Side.

An important element to assess is the institutional knowledge of the current physical and social vulnerabilities in the basins and the potential impacts of climate change upon the systems of water supply to human settings, such as rural communities.

In these terms we are interested in the ability of the institution "to be sensitive to early signs of problems" (World Bank, 2003: 185-186) in the area of impacts of climate change, especially water resources. The existence of appropriate information systems that allow for the gathering and evaluation of information and to make a reasoned decision based on the information –what Homer Dixon calls "instrumental rationality"—are central factors in fostering this sensitivity. Obviously, the issue is not only the capacity to collect information, but also "the quality" of the collected data in terms of identifying local problems and issues, the needs of different social groups, as well as the ability of the institutions to "return" this data to different constituencies. In these terms, some of the issues that are important to assess in the input side are:

1. The type of information that is collected (i.e. information about quantity and quality of water resources).
2. The level of information (how spatially disaggregated is the information).
3. Information gathering techniques (i.e. the collection of "ground-truthing" information as a way to grasp local problems and impacts).
4. The purpose(s) for collecting the information (i.e. to monitor, to diagnose, and to manage problems) and its effective use for decision-making.
5. The capacity of the data to identify the needs and problems of different groups.
6. How the data is organized (databases).
7. The creation of information for stakeholders and the development of stakeholders for information. Availability of the data to other public institutions, organizations of the civil society, and individuals and the way in which this information is made available.
8. The capacity to predict problems based on the collected data.

The Processing Side

The identification of problems –vulnerabilities in our case-- imposes a fundamental task upon public institutions: to resolve the identified problems in a way that balance the interests of the diversity of stakeholders. The capacity to resolve problems requires also some features that are "internal" to institutional actors, such as the existence of proper resources in the institutions and their ability to link to other institutions in order to coordinate the solution of problems. A key list of factors to assess in the "processing side" is:

1. The procedures followed by the institutions to deal with those vulnerabilities, from the moment in which vulnerabilities are identified to the moment in which solutions are ready to be implemented (i.e. reactive and/or active responses).
2. In order to avoid policy measures that may favor specific stakeholders (rich farmers, corporations, etc.) it is also necessary to assess how the diversity of interests is considered during the identified procedures. For example, the World Bank (2003; 187)

emphasizes two elements in this process of balancing interests: getting everybody represented in the decision making process and facilitating the negotiation process.

3. In order to evaluate the fairness of the public institutional procedures, it is also necessary to evaluate the existence of a variety of institutional tools such as transparency, performance reporting, and accountability (World Bank, 2003: 187). Issues to evaluate here are the existence of reports to stakeholders, their distributional channels of these reports, and the openness of institutions to make procedures transparent, among others. These tools do not only provide stakeholders with clear information about public agencies' procedures, but they also provide them with the opportunity for self-evaluation.
4. The existence forums and networks of negotiations during the process of finding the best solution the problems identified in the input side (World Bank, 2003). For example, the implementation of stakeholder meetings by the public institutions could be an important tool that helps to reduce tensions between different water users, to establish fair systems of distribution, and to create social capital within the civil society.
5. The existence of compensation and incentives (World Bank, 2003). Resource scarcities always produce a loser, so it is important to minimize losses, compensate losers, and provide incentive for the development of new initiatives.
6. The availability of resources, human capital and fiscal resources, within the institutions (Homer-Dixon, 1999). The absence of certain type of skills and/or financial support could impede institutions of developing their adaptive capacities, so it is necessary to assess the existence of these resources at each stage of the problem-resolution process.
7. The degree to which different institutions agree and act on shared bases, objectives, and methods. This institutional coordination involves the ability of different agencies to communicate and constructively to debate ideas, information, and solution to problems among themselves.
8. The existence of institutional barriers, such as management practices that affect the decision-making processes. For example, the existence of highly centralized structures of power within institutions.
9. The institutionalization of climate change and of adaptation as a viable strategy, in the mandates and decision-making process of the institution.

The Output Side

The adaptive capacity of the institutions must involve also the existence of capacities in terms of implementing the solutions discussed and decided in the "processing side" to the problems found in the "input side". Some of the factors that should be taken into consideration in this area are:

1. The capacity of public institutions to inform about their decisions and of the procedures to implement them.
2. The capacities of the institutional solutions, embodied in policies and programs, to promote capacity building and problem solving within the civil society, such as the implementation of mechanisms oriented to expand social capital and network for mutual support within the rural communities.
3. The strengthening and/or development of NGOs and grass-roots organizations that promote the management of resources and the adoption of adaptive measures to resource scarcities.
4. Monitoring and evaluation. The capacity of the public institutions to monitor the application of the solutions and to evaluate their degree of success.

7. Institutional adaptive capacity and discourses

Successful institutional adaptive capacity does indeed depend upon the ability of an institution to interconnect adaptive measures into a *structured* adaptive capacity. Success of institutional adaptive capacity here hinges on the ability of an institution to have *access to*, and the *means to develop* and *ability to interconnect* adaptive measures weaving the following components together: technology, assets, capital resources, human and social capital, scientific knowledge, effective social networks, flexibility to deal with uncertainties and anticipate problems and solutions, innovative capabilities, ability to manage risk and challenges in a way that balances social, economic and natural interests. These components also rest heavily upon the input, processing and outputs of broader political systems operating in the many different sectors of civil society.

Ultimately, however, what is considered "successful" in institutional adaptive capacity depends a great deal upon the *main discourses* (value-frameworks, paradigms and models) articulated by the many and various constituents making up the climate change community. These discourses are important because they not only define the nature of the problem (what is to be asked) but also frame the possible solutions (what is to be done). Thus, different responses, such as institutional adaptive capacity measures formed in response to the impacts of climate change, reflect different core values, scientific and cultural paradigms that they are explicitly or implicitly founded upon.

Scientific Models:

The way in which the scientific community responds in how it determines the implications of climate change, aids in informing which and by/with whom adaptive responses are decided and implemented. Typically, **a positivistic approach** is taken, whereby computer models construct past, present and artificial future scenarios, an impact model is then developed, and then the specific climate change impact(s) and scenarios are determined. Small variations in this linear framework "include the use of analogue events (e.g. a signal drought), and changes in variability (and therefore risk) in addition to changes in climatic means" (Downing, 2003). According to Downing, 2 dominant approaches are taken in climate research: (1) regional studies, where sectoral assessments are conducted and often linking climate scenarios with biophysical impacts, and (2) global integrated assessments, where assessments are conducted across sectors based upon "abstract mechanisms (e.g. markets to mediate resource allocation) or with limited and constraining interactions between sectors" (2003). These processes are typically linear ones, and rest on the belief that technology and human ingenuity can predict reality 'out there'. The construction of this reality ''out there'' becomes knowledge that is determined by scientists, and often understood mainly by other scientists and citizens that are post-secondary educated. Adaptive approaches to determined climate change scenarios and impacts are thus often created and implemented in a top-down process.

Other approaches are informed by **social constructionism**, whereby stakeholders are asked by researchers or facilitators what their perceptions are about climate change. The researcher is not testing a theory here, rather building one. For example, a researcher may hold an open forum with a farming community and ask what the farmers' experiences are with climate, is it changing, what are the impacts, etc? Reality here is a social construction, where reality exists inside the lens of the participant. Adaptive approaches are more likely here to be created and implemented with and by the community the reality was constructed within in a bottom-up collaborative process.

Other approaches that are increasingly being used are those informed by **complexity theory**. Complexity theory, which first emerged in physics and mathematics, "is concerned with stability and change in systems that are complex in the sense that they consist of a great many independent agents that interact with each other in many ways" (Waldorp, 1992) and a central tenet of this

theory is that "under certain conditions, systems can behave chaotically" (Gardner, G., and Stern, P., 1996). Three main strands of this theory exist: (1) **Chaos theory**, where "chaos stems from the unpredictability of the combined interactions where small variations in each of them can accumulate into large consequences" (such as butterfly flapping its wings in one place and causing a storm in another place and nothing at other times); (2**) Dissipating structures theory**, where "changing conditions (such as supply and energy) leads to the spontaneous formation of new structures", and (3) **Complex adaptive systems**, where adaptive systems actively process information and act accordingly to their own intentions (Hilhorst, 2004). Where these theories depart from one another, is how the phenomenon of responding happens (passive versus agency) and types of principles underlying them - social constructionism and positivism. Chaos theory often rests upon principles of the positivist approach, whereby there is a desire to predict uncertainties, reality exists 'out there' and it is desired to be discovered as soon as the principles of predictability and thus control are discovered. According to Stacey et al. (2000), unpredictability here refers to the "inability of humans to measure with infinite accuracy", and according to Possekel (1999), "complexity becomes equivalent to the computer time needed to analyze the system" (in Hilhorst, 2004). Thus, adaptive approaches here, while acknowledging that the impacts of climate change are unpredictable, implicitly this theory implies that once scientists master their computer models it has the promise of becoming predictable. Also, adaptive approaches here construct knowledge in ways that are mostly understood by scientists and the "educated"; thus limiting public understanding and participation in responses. Conversely, **complex adaptive theory** rests upon principles of the social constructionist approach, where multiple realities are acknowledged, and whereby unpredictability "stems from the creative interaction of sense making and diverse agents" (Hilhorst, 2004). Thus, acknowledging that the impacts of climate change are *radically* unpredictable, adaptive approaches would "necessitate a reflexive scientific expertise that incorporates a wide array of lay and local knowledge" (Backstrand, K., 2004), agency for components to adapt locally, and the need to acknowledge multiple realities when developing adaptive approaches and responses that are flexible for a wide range of uncertainties.

Value frameworks and Paradigms:

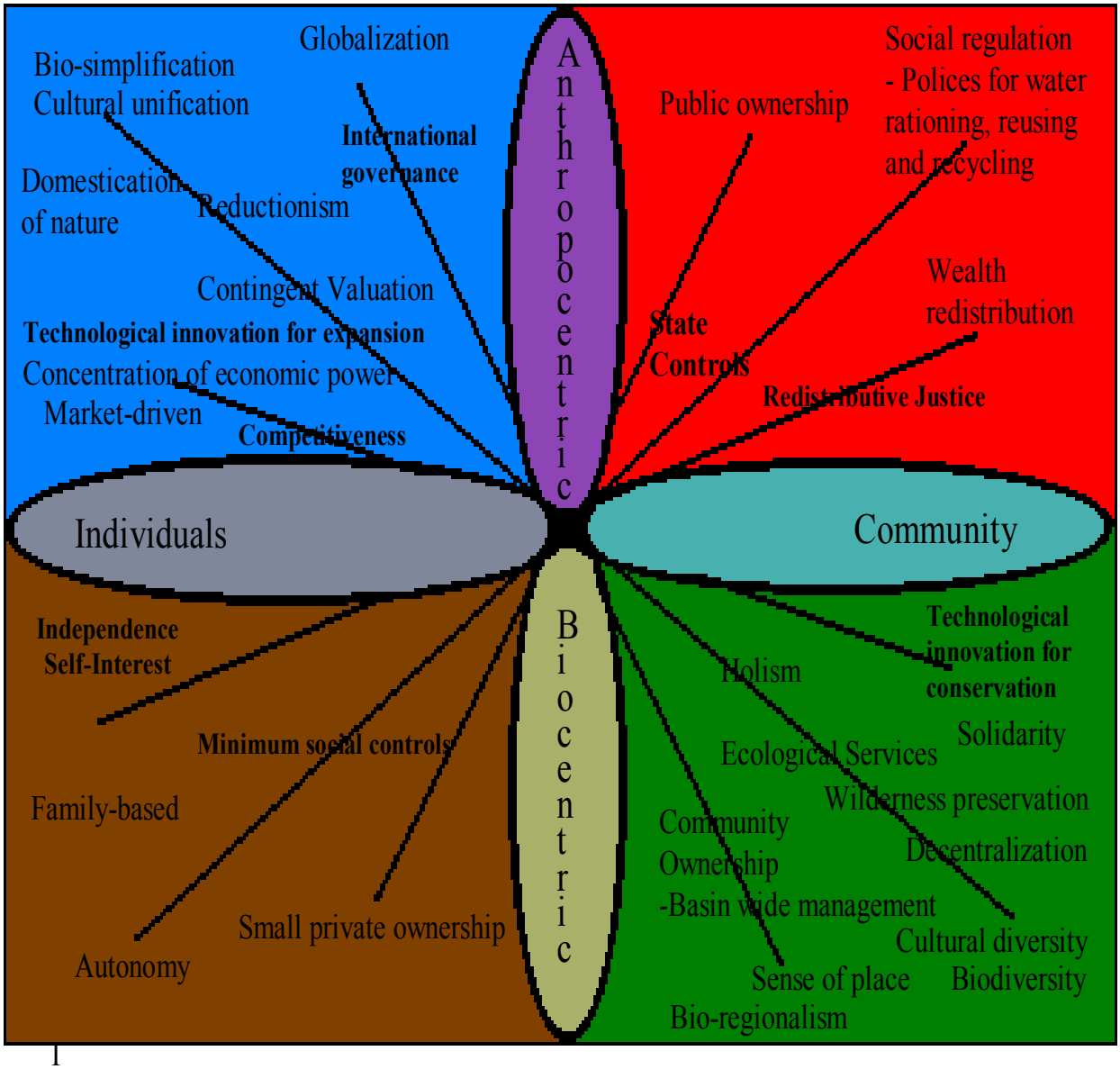
Defining adaptive capacities that enable a system to cope with climate change, such as perceptions of vulnerability are quite varied within the climate change community, which also includes the policy-makers and politicians involved in the articulation of responses to climate change. Some stakeholders consider vulnerability in strongly anthropocentric terms, where it is considered more characteristically "about people" rather than "people in places". That is vulnerability is a social phenomenon relevant to particular social groupings, whether demographic (elderly, young), economic (livelihoods, entitlements) or political (marginalized). It is people who are exposed (ultimately) to climate extremes, and to longer term climate change" (Downing, 2003). Others consider vulnerability in more bio-centric terms, to include "biophysical entities, such as ecosystems or coastlines, and to social aspects, such as social systems, economic activities, countries, and others" (Diaz, 2004). The first perception is purely anthropocentric because it reduces the effects of climate change to pertain *only* to human systems and the biophysical forces they are exposed to, excluding other biological realities and ecological relationships; whereas the latter perception is a more holistic approach and situates humans *within* the environment, where climate change affects all components and relationships within the eco-system.

Arguably, most discourses on climate change (as most ideological constructs) can be located within the interface of two key axis representing continuums of human values: a continuum having as it core values, on the one hand ***individualistic-oriented ideologies advocating***

individual freedom above everything else and on the other, ***socially-oriented ideologies emphasizing social and community responsibility*** above everything else. This is of course, the well known axis within which right and left ideologies clash. The former advocating unrestricted entrepreneurial freedom, understood from that perspective, if not as a synonymous of individual freedom, at least as its most important pre-condition: free-market economics and possessive individualism are here the drivers of human progress. The later, on the contrary, advocates diverse mechanisms of social regulation to arrange more egalitarian distribution of wealth. However, particularly since the emergence of environmentalism another axis of clashing values has emerged: a continuum having on one end, ***human-centered or anthropocentric ideologies*** and on the other end, ***biocentric or ecocentric ideologies.***

The contradictory and varied responses to climate change can be located within the 4 axis or petals in a **Paradigmatic Flower** (See Diagram 1 below). In each axis is a cultural or ethical paradigm, and in each quadrant is a corresponding spectrum of core values. Below, we will use this flower model to illustrate the climate change debate, with a focus on responses pertaining to climate change impacts on water. It can show how institutional responses reflect different core values and paradigms, and aid in explaining how and why different consensuses have been reached. Different policy environments respond at varied combinations of these discourses.

Diagram 1: Paradigmatic Flower



Rojas, A. 2002, Rojas & Richer, 2004

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Flower index:
• **Individual freedom** refers to the notion of individualism, whereby the well-being of individuals takes precedent over the well-being of the community.
• **Community Responsibility** refers to social responsibility, whereby individuals should act with the interest of the community needs, or common good first, before their own individual wants.
• **Anthropocentrism or human-centrism** refers to a philosophical perspective which asserts that ethics is an intra-human phenomenon and that "humans are under no moral obligation to

extend their own internal codes of behavior to other species…it is both illogical and impractical to extend moral concern beyond the human community" (Guthrie, 1976). Proponents of **strong anthropocentrism** value nature instrumentally, where nature exists to satisfy human wants, desires and socially constructed needs, because human interests are deemed the highest; thus nature exists as a means to serve human ends. Proponents of **weak anthropocentrism** recognize the moral validity of "considered preferences", such as basic human needs and desires that are expressed after careful deliberation (Norton, 1986). While human preferences are deemed the most important in this perspective, here the natural world is also valued because its health is deemed necessary for human survival.

- **Biocentrism or ecocentrism** is a philosophical perspective which asserts that the natural world has intrinsic or inherent value; the natural world is not a means to an end, but an end in itself. Thus, humans have an ethical responsibility towards the natural world, where nature should be valued according to its own right, rather than to its use value to humans, this can be referred to as the "Land Ethic" (Leopold, 1948).

Responses to climate can be mapped, explored and assessed within these large value frameworks and paradigms they tend to support. For the sake of simplicity we will assign colors to the different position (a similar exercise of color mapping political discourses was proposed by J. Galtung, 1983). ***The Blues*** occupy the ideological space resulting from the intersection between individualism and strong human-centered values. ***The Reds*** are placed in the space resulting from the intersection of social responsibility and strong human-centered ideas. ***The Green*****s** can be located in the intersection between social responsibility and bio-centrism. ***The Browns*** can be located in the intersection between individual freedom and bio-centrism.

There are many ways that institutions are currently and planning to adapt to the climate change impacts posed on water resources. These responses vary by the level of adaptive response, such as international, regional, local or individual. They also further vary by institution: formal or informal, public or private, those founded in civil society, the market, or government, and also by their level and type of adaptive capacities. The analytical language used in the climate change literature varies in the ways forms of adaptation are described. Forms of adaptation can be anticipatory or reactive, autonomous or planned (Diaz, 2004), proactive or reactive (Paavola, J., and Adger, N., 2004), and precautionary or anticipatory (Mendelsohn, R., and Bennett, L., 1997).

The way that institutions value water informs how they decide to adapt to climate change – their adaptive responses. Most tend to cluster around 2 streams: (1) contingent valuation, and (2) ecological services. In contingent valuation, the value of water is identified by its use value for human needs and wants. It is a method used to measure the "value of non-market and non-use goods and services" in an effort to "estimate respondent's value of the resource or action in terms of willingness to pay (WTP) or willingness to accept (WTA)" unrealized environmental changes (Duberstein, J., and deSteiguer, J., 2002). Contingent valuation can be based upon anthropocentricism (strong or weak), and can be located in the 2 ("Blue" or "Red") upper quadrants in the flower model between individualism and community. Examples of adaptive responses informed by contingent valuation, such as WTA water scarcity, can be illustrated if a farmer responds by deciding to rely on crop insurance and/or decides to diversify farm income. Here the farmer decides to accept the problem if he/she finds extra sources of income, and/or receives crop insurance. WTP for water scarcity can be illustrated if a farmer responds by deciding to invest and build a large scale irrigation system and/or decides to rely on dams. Here the farmer decides to pay for the problem by investing or building infrastructure to circumvent the problem of water scarcity. Ecological services considers the value of water to be defined by its intrinsic value and/or as an essential contributor to the health of the ecosystem upon which

human life depends. For example, water can be considered as a divine, transformative, and living being; it is a "common patrimony that belongs to the earth and all living beings" (IRDC, 2004). Ecological services can be based upon biocentrism and can be located in the lower right ("green") quadrant between biocentrism and community. An example of an adaptive response informed by ecological services can be illustrated if a farmer decides to diversify production, enhance water conservation, and increase reliance on the services provided by nature. Here the farmer tries to minimize potential adverse affects of climate change to increase or maintain water availability within regional carrying capacities.

Specific responses:

The impacts that climate change poses on water resources typically involve 3 main options for adaptive responses: (**1) increase supply; (2) decrease demand; (3) increase institutional flexibility** (IPCC, 1995; Snover et. al., 1998; Mote et al., 2003). These categories are not tidy and distinct; rather much overlap exists in responses that include increasing supply and decreasing demand, etc. Many responses that deal with climate change impacts on water resources involve increasing supply. Adaptive responses typically concern building and investing in engineering and infrastructure, such as building dams, large-scale irrigation systems, and drilling water wells (SSCAF, 2003). These responses fall in the upper left ("Blue") quadrant of the flower between anthropocentrism and individuals, since these responses rest upon the notion of further domesticating nature. Other responses involve creating a tiered water pricing system, where either price would be assigned to specified quantities of water, or according to high or low value use (Frederick, 1997). It is assumed here that market prices will naturally promote conservation. This response, if carried out alone, rests upon the assumption that the market will take care of things. Thus, this response can be located within the upper left ("Blue") quadrant of the flower between anthropocentrism and individuals since the market is deemed the ultimate determinant of social behavior.

The debate that preceded and followed the recently adopted reforms to the Chilean Water Code can be neatly positioned within this framework of competing, conflicting and sometimes overlapping values. The central values embedded in the Water Code established by the military regime in Chile, which created the "water markets" and embarked the country in a process of commodification of water fell squarely in the upper left ("Blue") quadrant in the interface of individualism and strong anthropocentrism. The reforms to the Code finally enacted by the March 2005 resolution of the Chilean Senate represents a significant displacement towards a weak-anthropocentric and socially-responsible position. Without dismantling the role of the market as a mechanism of allocation of water resources, it provides the Chilean state, through the re-invigorated position of the Direccion General de Aguas (General Direction of Water), with new regulatory tools aiming at arresting the growing process of concentration of control of water in the hands of large agricultural conglomerates and mostly, the monopolistic control of water rights in the hands of ENDESA, the formerly publicly owned and subsequently privatized by the military regime, monopoly of electricity. These reforms are a result of an informal red-green coalition, where questions of re-distributive justice in access to water rights aiming at protecting the most vulnerable sectors is complemented by a greener response aimed at preventing the overuse of water resources in particularly sensitive ecosystems.

The political support of the centrist-left coalition of the Concertacion Democratica (the ruling coalition) and the overt support of the environmental movement to the reforms speak as loudly as the overt opposition of right-wing think tanks like the Instituto de Libertad y Desarrollo. However, the final unanimity of the Senate vote in support of the reform indicates a complex pragmatism among the political elites, six months away from a new national election. These

cleavages show the extent to which shifts in the ideological climate of a country (clearly leaning according to the opinion polls towards the centre-left discourse) shapes opportunities and barriers for institutional adaptation. Institutional adaptations thus, are influenced to a very significant extent, by the values clashing, competing and overlapping in large ideological, overtly value-driven discourses.

Responses that involve increasing institutional flexibility, typically involve planning for a wide range of potential impacts on water by incorporating different strategies in management responses. One response is to identify policies to be pursued when conditions become either wetter or drier, where responses are then phased in to adapt appropriately to the effects (Miller, K., et al., 1997). This response can be located in the upper right ("Red") quadrant between anthropocentrism and community, since water here is publicly reallocated from low to high value uses in accordance with community needs. Another response is creating and preserving a water safety margin to prevent shortages, which encourages collective responsibility over water, cooperative and integrated basin wide coordination (Frederick, K., 1997; Miller, K., et al., 1997). This response is informed by a policy of no-regret and flexibility (Middelkoop, H. et al., 2001) and can be located within the lower right ("Green") quadrant of the flower since it implies community ownership, decentralized governance and bioregional sense of places.

Many responses that propose decreasing water demand are influenced by this no-regrets policy, which is a policy, advocated by the IPCC "that will generate net social benefits whether or not there is human induced climate change" (SSCAF, 2003). A host of adaptive responses exist that are informed by this policy. Government responses that encourage the public to conserve water include: "(1) advising the public of potential shortages and monitoring use; (2) requesting voluntary use reductions; (3) prohibiting inessential, high-consumption use such as watering lawns and washing cars; (4) rationing" (Mote, P. et al., 2003); (5) regulations for water reuse and recycling by industrial and commercial users (Miller, K. et al., 1997), and (6) creating measures to reallocate water to uses deemed higher value (Stakiv, E. and Major, D., 1997). Promoting farm production practices that encourage water conservation is a response that can involve: diversifying crops, conserving soil moisture and nutrients, using green cover and buffer zones, protecting wetlands, conservation tillage, water saving (such as with barrels and plastic covers), improving water uptake, and reducing runoff (Brown, 2003; Downing, 2003; SSCAF, 2003). These responses can rest on the principles of weak-anthropocentrism and biocentrism, and can be located in either of the lower ("Green" or "Brown") quadrants of the flower between community and individuals. These responses rest upon the belief that humans should increase reliance on the services provided by nature, to live within place, and enhance and preserve biodiversity. Finally, many technologies have been proposed to aid in improving water use and efficiency, such as investing in genetically engineered drought and heat resistant crop varieties, and creating more efficient irrigation systems. The assumption here is that adaptation can mean continuing on with business as usual but doing it more efficiently, by continuing to perfect mastery over nature. This response could easily fall in the upper left ("Blue") quadrant of the flower between individuals and anthropocentrism. But the response of developing more efficient irrigation systems could also easily fall in the lower right ("Green") quadrant of the flower between community and biocentrism, depending upon the operationalisation of the response; such as whether more efficient irrigation practices are implemented in a way that enhances conservation or expansion.

Ultimately, all of these adaptive measures and how they relate to discourses depends upon how they are operationalised. Thus, each adaptive response by itself can typically be located within almost *any* of the quadrants of the flower, because the way that each adaptive measure is operationalised depends upon which discourses inform the institutional operationalisation of the measure itself.

In short, the discourses (value-frameworks, paradigms and models) articulated by the climate change community to respond to the challenges presented by climate change, deeply affect the ways adaptive measures are formed and ultimately operationalised, greatly informing how the investigation of institutional adaptations should take place.

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