

VULNERABILITY AND ADAPTATION: The Canadian Prairies and South America Edited by Harry Diaz, Margot Hurlbert, and Jim Warren

ISBN 978-1-55238-820-4

THIS BOOK IS AN OPEN ACCESS E-BOOK. It is an electronic version of a book that can be purchased in physical form through any bookseller or on-line retailer, or from our distributors. Please support this open access publication by requesting that your university purchase a print copy of this book, or by purchasing a copy yourself. If you have any questions, please contact us at ucpress@ucalgary.ca

Cover Art: The artwork on the cover of this book is not open access and falls under traditional copyright provisions; it cannot be reproduced in any way without written permission of the artists and their agents. The cover can be displayed as a complete cover image for the purposes of publicizing this work, but the artwork cannot be extracted from the context of the cover of this specific work without breaching the artist's copyright.

COPYRIGHT NOTICE: This open-access work is published under a Creative Commons licence. This means that you are free to copy, distribute, display or perform the work as long as you clearly attribute the work to its authors and publisher, that you do not use this work for any commercial gain in any form, and that you in no way alter, transform, or build on the work outside of its use in normal academic scholarship without our express permission. If you want to reuse or distribute the work, you must inform its new audience of the licence terms of this work. For more information, see details of the Creative Commons licence at: <http://creativecommons.org/licenses/by-nc-nd/4.0/>

UNDER THE CREATIVE COMMONS LICENCE YOU **MAY:**

- read and store this document free of charge;
- distribute it for personal use free of charge;
- print sections of the work for personal use;
- read or perform parts of the work in a context where no financial transactions take place.

UNDER THE CREATIVE COMMONS LICENCE YOU **MAY NOT:**

- gain financially from the work in any way;
- sell the work or seek monies in relation to the distribution of the work;
- use the work in any commercial activity of any kind;
- profit a third party indirectly via use or distribution of the work;
- distribute in or through a commercial body (with the exception of academic usage within educational institutions such as schools and universities);
- reproduce, distribute, or store the cover image outside of its function as a cover of this work;
- alter or build on the work outside of normal academic scholarship.



Acknowledgement: We acknowledge the wording around open access used by Australian publisher, **re.press**, and thank them for giving us permission to adapt their wording to our policy <http://www.re-press.org>

PART 5

**STRATEGIC PLANNING
AND DROUGHT**

VALUES ANALYSIS AS A DECISION SUPPORT TOOL TO MANAGE VULNERABILITY AND ADAPTATION TO DROUGHT

Darrell R. Corkal, Bruce Morito, and Alejandro Rojas

Introduction

At a basic level, the term “vulnerability” refers to a relatively weak capacity to adapt to potential harms to humans or nature. Individuals, human communities, and nature itself are vulnerable to both natural stressors (e.g., droughts, floods, extreme weather) and anthropogenic stressors (e.g., pollution from human activities, infrastructure failures, economic downturns). This chapter assumes that vulnerability is, to a great extent, a socially constructed concept that expresses people’s orientation toward the harms that can befall them or the environment in which they live. This “vulnerability concept” is constructed in accordance with the values people hold, care about, and want or feel compelled to protect (Adger 2006). Values that individuals hold will influence group values (like-minded stakeholders, communities, institutions, government agencies) and vice versa. Established institutional values tend to be the most widely accepted values of a society or culture at a given location and in a historic place in

time. Institutions are also guided by values associated with organizational culture, structure, mandates, and legal instruments established by the society in which they operate.

This chapter is based primarily on data collected from diverse stakeholders (water users, the agricultural sector, rural communities, and all orders of government). The research focused on stakeholders who experienced the 2001–2 drought, one of the most severe droughts to have affected western Canada in decades and which was particularly severe for those in the South Saskatchewan River basin (SSRB), Canada. Agricultural production dropped by about \$3 billion, mostly in the Prairie region (Wheaton et al. 2008). This national drought caused a \$5.8 billion drop in Canada's gross domestic product (GDP), 41,000 job losses, and a \$3.6 billion drop in Canadian agricultural GDP (Wheaton et al. 2005). Drought and climate-induced water stress are recurrent, natural characteristics of the Prairies and affect the social, economic, and environmental fabric of the SSRB (Sauchyn et al. 2010; Marchildon 2009a, 2009b; Banks and Cochrane 2005 Gray 1967).

The task in this chapter is to present examples of value orientations of stakeholders and governance institutions with reference to stakeholder vulnerability to drought. Some of the normative concerns in this context are identified and a values analysis methodology is provided to help identify stakeholders' different values. A conceptual decision support tool is presented as a method to help stakeholders better understand and resolve conflicts, and develop better adaptive responses to drought risks.

Values and value commitments (or value systems) underlie all intentional, deliberate, and planned thought and action. They belong to a mostly implicit system of knowledge, beliefs, and common understandings that contribute to social, cultural, and institutional structures. In turn, the organizational culture and structure shapes the practices of people and the institutions they represent. Values are key factors that contribute to the expression of meaning, thought, and human action. Values, therefore, contribute to the manner in which people legitimize decision making and establish governance systems and policies.

Values analysis¹ helps us understand the underlying concerns and motivations of individuals, groups, communities, industry, institutions, and the wide spectrum of decision-making bodies. Values analysis is consistent with recent interest in including "stakeholder analysis" along with

“shareholder interests” in resource management. In part, this relates to the concept of “a social licence to operate” of a particular sector such as agriculture; that is, the sector’s activities must be acceptable to society, or else it may conflict with competing interests. Values analysis recognizes economic and environmental factors (Morito 2005), as well as social, ethnographic, and institutional factors (Morito 2008; Morito and Thachuk 2008). In our study context, Patiño and Gauthier (2009) provide an excellent overview of the complexity of SSRB stakeholders. They emphasize the importance of understanding who the stakeholders are and how they relate to each other. They suggest public engagement and participatory mapping to help integrate and foster dialogue and co-operation between diverse stakeholders and decision makers.

Hence, a values analysis helps us understand the “reasons” and motivations for decisions, policy, action, and conflict. It provides a framework for conducting a deeper analysis of conflict and may help guide approaches toward successful conflict resolution. It will help identify whether conflicts are relatively superficial and involve negotiable values or whether they are more deeply entrenched and may first require establishing common ground to allow stakeholders to better understand their differences before conflict resolution can begin. The initial phase of a values analysis is to create a context of mutual understanding to determine whether there is a basis for a common ground. Values analysis can help identify “institutional personalities,” which may provide insight into understanding how individuals, groups, and institutions (including government agencies and industry) will act and interact. A values analysis can also help guide policies and initiatives and help determine whether they are achieving their intended results and are on an appropriate track.

Values Analysis Methodology: A Case Study with IACC Stakeholder Communities

This chapter is based on the field results of the Institutional Adaptations to Climate Change (IACC) research project. The project was conducted from 2004 to 2009 in Canada and Chile to improve our understanding of climate stress vulnerabilities and to consider how institutional adaptations may be useful in strengthening the resilience of rural communities and the agricultural sector. The study region in Canada was the SSRB,

spanning the provinces of Alberta and Saskatchewan. Water was chosen as the focal point for our values analysis, as stakeholders confront impacts from extreme climate. The interconnectedness between water and stakeholder/institutional adaptations is more fully described in Rojas and Richer (2005).

We conducted numerous semi-structured interviews and focus groups involving diverse stakeholders with vested interests in water: individuals, rural communities, farmers, farm groups, agricultural industry, First Nations, non-government groups such as watershed organizations and environmental agencies, and all orders of government (local, provincial, and federal agencies). The interviews were audio-recorded, transcribed, and subsequently coded using NVivo software to allow analysis and interpretation. Interview respondents provided their own perspectives on risk, vulnerability, resilience, governance, and adaptation. We used an interview guide to elicit information and perspectives on drought, water management, water conflict, gaps in adaptive capacity, and opportunities to strengthen resilience.

This values-analysis case study focused on Canadian communities in Saskatchewan (Outlook, Stewart Valley, and Cabri) and Alberta (Hanna, Taber, and Blood Tribe First Nation), and on institutions responsible for water governance in the two provinces. Comments on groups and institutions are based mostly on aggregated results, although interesting contrasts between Alberta and Saskatchewan warrant the identification of specific institutions and in some cases specific individuals (anonymous, but cited by a code) or specific stakeholder groups. We provide only a summary of the research results and highlight those features that aid the value-analytic aspects of the research. It should be noted that the interviews and focus groups were structured to be as open as possible to allow stakeholders to indicate what they did in response to drought and what they thought was important for them to mention, and to allow other participants' responses to stimulate discourse of related concerns.

Main Observations of the Values Analysis from Respondent Interviews

Common and recurring themes of values occurred, and the data were organized in four categories, as developed by Rojas (2000), one of the

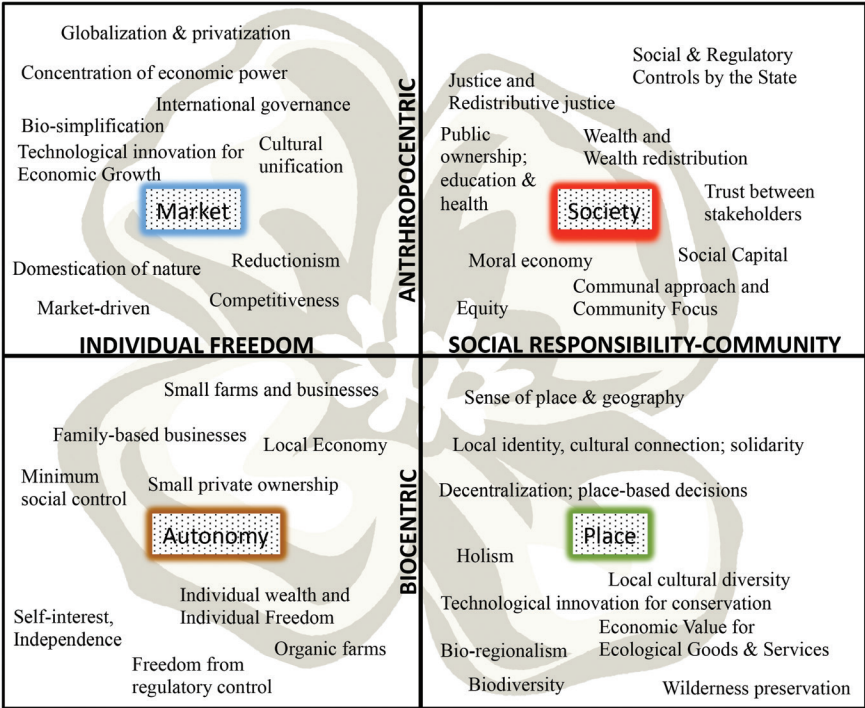


Figure 1. Flower of Values: values characteristics within four quadrants (Source: modified from Rojas 2000; Rojas, Magzul, et al. 2009; and Rojas, Reyes, et al. 2009)

co-authors of this chapter. The “Flower of Values” graphic (Figure 1) is presented as a key visual aid to explore the relationships between human values and the way water problems were defined by different stakeholders. Understanding the ethical basis of the way different stakeholders react to water risks is critical knowledge for those vested with the responsibility of making informed decisions for adaptive planning and action.

The “Flower of Values” graphic is a conceptual framework that combines cultural and ethical paradigms. Four paradigms are used: anthropocentrism, biocentrism, individual freedom, and social responsibility/community. The diagram helps situate the various value profiles and their relative commonalities and contrasts. These typical societal values characteristics are sorted into four quadrants: market, society, autonomy, and place. For example, in the upper-right quadrant (anthropogenic and social

responsibility, labelled as “Society”), value is placed on public ownership, social regulation, and wealth redistribution. In the bottom-left quadrant (individual freedom and biocentric, labelled as “Autonomy”), value is placed on freedom of choice and small-scale operations sensitive to sustainability. In the upper-left quadrant (market competitiveness, globalization, labelled as “Market”), free market principles are most highly valued. In the bottom-right quadrant (local identity and geography, labelled as “Place”), local culture and ecology are most highly valued. In general, the most strongly held values are those depicted the greatest distance from the center of the graphic.

Market and Economic Values

The interviews were conducted relatively close in time to the 2001–2 drought, so its severe economic impacts were top-of-mind with stakeholders. The ecological impacts were more or less successfully managed largely because of two key factors: the drought lasted only two years, and many historical adaptations (e.g., low-tillage crop seeding, irrigation, better water management) were successful in strengthening resilience (Toth et al. 2009; Bruneau et al. 2009). Accordingly, it comes as no surprise that most stakeholders described their vulnerabilities and adaptations to drought (and other water-related concerns, such as flooding) by emphasizing the importance of sound economic and technological instruments. They suggested a need for investing in technological and infrastructure development, and for revising such economic instruments such as crop insurance. When referencing past adaptations, they often talked about how they built water reservoirs and distribution systems, established irrigation projects, and later improved irrigation water use efficiency with new technologies. Many also mentioned how they shifted their operations to produce different crops. Many stakeholders complained about domestic and/or international policies and government actions (or lack thereof) that placed them at a disadvantage. For example, government responses to world market fluctuations, trade barriers, and subsidies were mentioned as key factors that made it difficult, if not impossible, for farmers to compete in the world market.

Autonomy and Individualistic Values

Some stakeholders first mentioned, emphatically, the importance of the individual and local community. This focus on autonomy affected the types of economic activity and adaptive capacity. Respondents often mentioned how they, as individuals and as local communities, dealt with drought by self-resilience and without government aid or help from others outside of their region. Indeed, particularly in Alberta, a number of communities emphasized the importance of keeping government out of their business as much as possible. These responses are indicative of the values of freedom of choice/action and individual autonomy.

Society and Communal Values

Communal adaptive responses were also observed, particularly in relation to times of crisis such as the 2001–2 drought. Respondents told how they drew on resources such as their neighbours to salvage irrigation crops during times of water scarcity (i.e., when water supplies could not meet irrigation demands). In this extended drought, respondents drew on communal commitments and assessed their vulnerabilities and adaptive strategies that best fit the community while balancing individual needs where possible. In Alberta, where initial profiles would normally be positioned squarely in the autonomy and individualistic values quadrant, for instance, some community members in the irrigation districts decided to share water resources despite having priority rights under the first-in-time, first-in-right (FITFIR) system of allocation and adopted “water market characteristics” to transfer water rights (Nicole and Klein 2006). Priority rights holders sometimes shared their water resources by producing a crop on one person’s land and leaving the other’s land unseeded (in fallow), and later sharing whatever profits accrued. In fact, this adaptive response was cited by a number of institutional respondents to highlight the importance of recognizing community relationships as a resource on which managers should be drawing (Morito 2008a). So, while individual autonomy was strongly valued, shared communal decisions could also be highly valued. The importance of community, neighbourliness, and other non-economic factors was strongly emphasized: “The importance of trust was repeatedly emphasized and a careful approach to building and

nurturing trust was advised” (Alberta Environment, initial presentation at Athabasca River basin meetings, Sherwood Park, 15–16 April 2008).

Different stakeholders’ points of view are illustrated in the following comments:

Some of them were right thinking ... in a very, very low flow year, unless they got an amazing amount of rain by chance, 60% [of the water allocation needed to meet the irrigated crop water requirement] ain’t going to give you a crop. And it’s probably going to cost you more in energy costs and whatever to put 60% onto your fields and get no return. So 60% is probably losing money. So those people just chose not to even play ... to sign up for the 60% ... we aren’t going to get crops if we do this so let’s use our 60% on your land ... I will share in helping you work your land and everything, we’ll just fallow mine for a year and we’ll put the two 60% on your property and we’ll share what we get for a crop. That was huge in terms of adaptation. And they did it. No bureaucrat, no politician, nobody planned it. The tools were put in place. (Morito 2008b)

Or, again:

Guys in the early 80s basically invented water sharing ... [it] ... wasn’t legal at the time, we made ways of making it work ... as long everyone agreed and no one was injured by it. No complaint, no problem. Anyway, by doing that, [we] proved it could work ... you had peer pressure amongst the community. It’s not going to work if you have to do it over a broad area where people don’t know each other. (Morito 2008c)

And:

There’s a variety of personalities who work for the government, some are more successful at making these things work than others. ... It’s a trust issue more than anything else. ... We used to say you only work with three people at a time... Then you gotta fine-tune the systems so that everyone

knows what's going on, and then we can make it work. (Morito 2008c)

That respondents changed their emphasis from “individual choice” to focus on “best communal choice” indicates stakeholders are flexible and will adjust values to suit a particular situation or need. In this Alberta case, the adaptive response appears to run somewhat contrary to expectations, namely, that water scarcity did not generate conflict but rather elicited co-operation.

When given the opportunity to tell their stories about how they responded to drought in the past, many community members discussed other impacts that drought and “unfair economic practices” had on them. They spoke about how unfortunate it was that their children had no future in farming and had left the community to train as professionals or to seek non-farming work. As proud as they were of their children, they lamented their leaving, since it marked the beginning of a loss of a highly valued way of life and heritage. They also talked about how they feared the prospect of losing their schools and churches, as declining populations made the maintenance of these institutions financially unfeasible. Some even emphasized that their school and other community infrastructure were quite important for their sense of identity and community solidarity, since these are the places where most community activities take place. Further, being able to support a hockey team or school team to compete against the neighbouring communities was important to many. These kinds of factors are recognized as “social capital”² because they are non-financial, non-commodity resources on which people can draw for a variety of purposes. In our study, we define social capital as local collective social resources and the ability and capacity to work together as a collective or as a community to strengthen resilience and adaptive capacity. Social capital refers to the intangible resources members of a community or society can draw on to accomplish something (e.g., trust, familial/community support). These factors also relate to the presence of a “moral economy”³ that places value or worth on something that is normally not recognized by market economies (e.g., valuing quality of life, social relations, commitments to sustain a healthy environment). We define the term moral economy as a system of exchange based on moral values and expectations, which enables effective communication and ordered social relations; the

moral economy relates to normative orientations that people bring to their social interactions (e.g., equity, fairness, respect).

During the 2001–2 drought, the creative water-sharing and water-market relationships were founded on strong social relationships, pragmatism, and trust. The respondents gave and appreciated aid from both peers and community. They valued and received strength and support from local social/community networks. These elements work alongside—and sometimes in spite of—the commodity-based economy. These observations are a reminder that people often place great value on their lifestyle, their relationships, the integrity of their communities, and the actual “places” in which they live. People express value for many intangible factors and not only on quantifiable economic characteristics or economic wealth.

Place: Local Identity, Ecology, and Place-based Values⁴

The emphasis on “communal values” was sometimes demonstrated as a strong sense of geographic connectedness and identity. This differed from the more anthropocentric view of community in the “social/communal/sharing” quadrant. The values associated with a connectedness to a unique “place” (i.e., the environment in which one lives) emphasize bio-centric characteristics with specific human cultural and ecological/geographic identity. The experience of losing a way of life is connected to the place and ecological systems in which the respondents live and on which they depend for survival. Their remorse over children leaving the family farm is tied to their place-based values. The land is not treated merely as an economic commodity to be exploited but as a place in which they are responsible for land stewardship.

The connectedness with place and local identity was also evident in responses by the Blood Tribe (Kainai) First Nation stakeholders. When discussing climate vulnerabilities and adaptation, respondents did not focus on economic vulnerability but rather on the lack of social capital; the Kainai valued trust and the ability to draw on a sense of belonging to a vibrant and respected culture and place. They made it clear that their sense of identity (who they are) and a sense of empowerment (political significance) were crucial to their adaptive capacity. The problems of the community were explained by references to their residential school experience,

the imposed band council system, and the past banning of traditional practices by the federal government, all of which have become quite familiar to Canadians. Gangs and drug abuse were cited as symptoms of this problem. Their vulnerability to the impacts of climate change (which in their case actually had much more to do with flooding than drought) had, in many respondents' minds, first to do with social and cultural erosion, before economics. Indeed, many economic instruments have already been used to help the community adapt to contemporary economic exigencies, but they have failed, often because there was little motivation by community members to use them or learn how to use them. While the lack of education was stated as one reason for this, many respondents cited the history of their relationship with the Canadian government and the social challenges previously identified as causes of their vulnerability. They referred to the paternalistic practices toward First Nations people throughout Canadian history, which have deeply eroded their capacity to draw on social capital and the moral economy, and which in turn have alienated their communities from the commodity-based economy. Social capital and the moral economy are therefore seen as important elements to equip people with the capacity to think through problems, communicate effectively, work together, and subsequently move to organize, coordinate, and then respond to various stressors. These perspectives demonstrate how the Kainai value their personal identity, their history, and their political and social situation. This is consistent with Magzul's (2013) and Rojas, Magzul, et al.'s (2009) findings, which describe how understanding First Nations' values is critical for resolving conflicts and implementing effective adaptations.⁵

Responses by the Blood Tribe members imply that they see their value system as having been undermined, violated, and ignored. Here, we must rely on some readers' familiarity with Aboriginal cultural values to make the following summary claim. The Kainai's cultural heritage is based on a close connection to the land and the obligations the Creator set for them to act as keepers of the land (again, a strong emphasis on "place"). Their connectedness to the land is also reflected in the connection people have to one another within their culture. Community is primary, and the connectedness to the land is fundamental. This connectedness, according to our analytic framework, also places the Kainai much more within the community and biocentric sectors.

The strong value of place and cultural identity was also illustrated in the Kainai's sister community, the Peigan (Pikani). Where stakeholders value "place," conflict may arise with stakeholders who value "individualistic autonomy." More traditional members of the Pikani had come into conflict with proponents of the Oldman River Dam in the 1990s over control of water distribution and proposed expansion of irrigation and the agricultural economy. The sacredness of certain cottonwood-inhabited riparian zones was seen as threatened by the flooding of a reservoir zone once the dam was constructed. The Pikani were not convinced (and did not accept) that the economic value of development was sufficient justification for the project (Rojas, Magzul, et al. 2009). Indeed, building the dam would violate or impair deeply held spiritual and non-negotiable values (Magzul 2013; Rojas, Magzul et al. 2009).

Discussion: Stakeholder Values as Identified by IACC Research

The values analysis data gleaned from this research offer insights into differing and overlapping perspectives among stakeholders. When contrasting values exist (opposing quadrants), there is a risk of disagreement or conflict. If only similar values exist (one quadrant), imbalanced decisions may occur. Values mapping provides stakeholders and policy makers with a greater awareness of differences, conflicts, and similarities, which can lead to more balanced decision making and conflict resolution.

An agreed-upon values mapping process can increase mutual understanding and agreement, particularly when expressed through institutional and policy instruments. Stakeholders and decision makers can use this process to develop mutual understanding of differences and seek consensus, with the ultimate goal of creating better adaptation decisions (i.e., planning and implementation actions will improve by incorporating broader interests). People will identify with what matters to them collectively and rally around balanced values and locally relevant adaptive responses.

In contrast, when the diverse, broader stakeholders' values are not recognized, the resulting policies, decisions, and actions will likely create conflict. Ignoring a group's value systems can devalue their moral economy and marginalize that community. Adaptive responses that do not

factor in relevant stakeholder values are therefore not likely to be effectively implemented, may undermine a community's adaptive capacity, and may increase vulnerability.

Increasing adaptive capacity and decreasing vulnerability, then, depends crucially on understanding and protecting stakeholder value systems (individuals, communities, institutions). Clearly, for the Blood Tribe, recognizing and incorporating more communal/biocentric values and traditional indigenous knowledge is necessary (though not sufficient) to reduce its members' vulnerability to drought (Rojas, Magzul, et al. 2009; Rojas, Reyes, et al. 2009). Even for other SSRB communities, a movement from individualistic to communal/place-based values is critical during times of drought stress.

Individual, Group, and Institutional Values

Examples of the interconnectedness of individual, group, and institutional values were evident in both the historical literature and the IACC research data. Gray's (1967) *Men Against the Desert* documents how Canada's federal government applied unique place-based agricultural research to address the economic, social, and environmental crisis caused by the multi-year droughts of the 1920s–30s. Agriculture and Agri-Food Canada's Dominion Experimental Farms research was integrated with the creation and efforts of a new institution in 1935: "The federal government established the Prairie Farm Rehabilitation Administration (PFRA) during the greatest environmental and economic crisis in twentieth-century Canada" (Marchildon 2009b).

Gray makes evident the fact that government research was focused on soil and water conservation and water development (i.e., sustainable agri-environmental practices). While this research explicitly targeted the physical harms produced by drought (e.g., the need to find better methods to reduce soil drifting from wind erosion or better water management methods to minimize impacts caused by water scarcity), the institutional efforts had strong social and communal aspects. Research experiments and adaptation activities were conducted with the rural people and were intimately linked with rural communities and the rural populations on the farms they served. Gray's observations show that the institutional values recognized the importance of both individual and communal values. One could argue that recognition of both social capital and the moral

economy were implicit in the activities of the PFRA, as the institutions of the day (local, provincial, federal) were working hand-in-hand with the local rural farming communities and farm groups. The agricultural scientists and engineers worked directly with farmers to determine best land-use practices and best crops suited to prairie climate and to find improved soil and water management techniques. This communal effort was driven by a common need to find sustainable farming practices that could ensure greater economic security and vibrant rural communities.

During the course of the IACC research, those departments/ministries most responsible for water management were Alberta Environment and the Saskatchewan Watershed Authority in each respective province. Both provinces have been moving toward a more consultative process with stakeholders, a shift from the top-down regulatory approaches of the past. One high-level government respondent (Morito 2008d) emphasized that this is consistent with a worldwide shift initially established in the 1992 Dublin Principles, now commonly known as “integrated water resource management” (IWRM). IWRM is a process that attempts to involve the interests of all stakeholders when making water management decisions. It emphasizes social and economic values while committing to environmental principles and citizen engagement (World Meteorology Organization 1992; Global Water Partnership n.d.; IRC 2009). Similar integrated approaches are now formalized in Alberta’s Water for Life strategy (Alberta Environment 2008, 2003) and Saskatchewan’s *25 Year Saskatchewan Water Security Plan* (Saskatchewan Water Security Agency 2012⁶). Collaboration and engagement with citizens and all orders of government (including First Nations) are key factors in the longer-term strategy. Provincial and federal government institutions are also working together on interdisciplinary planning approaches to address interjurisdictional and multi-stakeholder concerns related to climate and water (Corkal et al. 2011, 2007; Diaz et al. 2009; Hurlbert, Corkal, et al. 2009; Hurlbert, Diaz, et al. 2009). Local watershed groups were created and are now developing more holistic watershed plans and advising governments of local needs and interests; their efforts are clearly founded in the “place-based” quadrant and consider economic, social, and environmental factors.

The IACC research data also demonstrate that institutional relationships are interconnected with local individuals and watershed groups. Several provincial government managers in Alberta (Morito 2008a) indicated

how they or their colleagues worked with the communities by drawing on friendships and familial ties to engage stakeholders in informal discussions to initiate adaptive responses to drought. These managers appealed to people's senses of honour and neighbourliness to comply with regulations.

Agriculture and the "Voice of the Environment"

The IACC research data indicated that diverse stakeholders expressed an interest in environmental sustainability. Interestingly, in the Alberta case where water is essentially fully allocated, agricultural producers and environmental groups appeared to be more proactively engaged in watershed planning, in essence trying to find consensus. In contrast, in Saskatchewan where water was not fully allocated, environmental and agricultural industry groups appeared to take stronger opposing views, leaving little room for consensus.

A number of respondents from government institutions emphasized that farmers and ranchers are not exploiters of the land (this viewpoint is sometimes identified by those who criticize the sector or its activities that pose risks to the environment). Respondents noted that farmers and ranchers are connected to, and depend on, a healthy natural ecosystem for their livelihood and quality of life. They see the land as their home; their way of agricultural production is a matter of lifestyle. They do not merely depend on the land for economic survival. Rather, their relationship to the land is critical to their identity and forms a kind of agricultural tradition and culture. Respondents told how some dryland farmers refused to become irrigation farmers. Some even felt that those family members who either had made the switch or advocated a switch to irrigation were traitors who were destroying a long-established and hard-won tradition of dryland (rain-fed) agriculture. To be fair, the decision to become an "irrigator" is replete with risks due to, for example, market conditions, investment costs, environmental/climate uncertainty, and long timelines to see a return on their investment (see Chapter 6 by Warren on irrigation in southwest Saskatchewan in this volume). However, the point remains that some respondents emphasized loyalty to long-standing traditional practices of dryland farming as a way of life. Again, in times of stress, more communal and biocentric values become important. As with the more traditional Peigan, who could not compromise their spiritual values

to accept the flooding of their sacred cottonwoods, the agricultural sector may also resist certain adaptations that conflict with identity and heritage values, even if a compelling economic rationale exists.

While the agricultural sector is an “economic activity,” the production of safe food is also seen as a “managed ecosystem” that tries to balance economic and ecological benefits (Swinton 2008). Farmers themselves see value in protecting water supplies and are adopting beneficial land and water management practices (sometimes as ecological goods and services), often with support from government programs (Corkal and Adkins 2008; Corkal et al. 2004). In effect, these initiatives are recognizing a diversity of values systems at play.

The Role of “Boundary Organizations” in Values Analysis

Bridging differing or conflicting values systems and competing interests will often require boundary organizations working with stakeholders to balance social, economic, and environmental values (Batie 2008; Clark and Holliday 2006). Boundary organizations are non-partisan and work with dual accountabilities, linking policy, science, and user-driven local knowledge to strengthen adaptive capacity.

The PFRA was historically an organization that had the elements of a boundary organization. The severe droughts of the 1920s–30s caused extensive social, economic, and ecological hardship on the Canadian Prairies (Marchildon 2009a, 2009b; Marchildon et al. 2008; Gray 1967). The PFRA’s mandate was to identify and promote soil and water conservation techniques, sustainable agricultural practices and land use, and improved water management approaches suited to the unique semi-arid characteristics of the climate and geography of the Canadian Prairies. In essence, the PFRA was promoting agricultural sustainability (market values) that were more suited to the regional, social, and place-based needs of the unique climate and geography of the Prairies (i.e., balancing communal and place-based values with market values).⁷

Many stakeholder groups interviewed by the IACC researchers appreciated the historical role and actions of PFRA, which were applied at a local scale. The stakeholders expressed criticism for approaches that did not take into account the local people or local communities; they criticized

“top-down” measures imposed by “far-away” agencies. Stakeholders desire institutions that co-create knowledge and adaptive responses with local efforts (i.e., a dual accountability).

The watershed groups in Alberta and Saskatchewan are modern-day boundary organizations. These groups work to bridge science, policy, and various institutions and programs to help meet the needs of local stakeholders with suitable adaptive responses in their specific geographic locations.

Insights from the IACC Values Analysis

The IACC research provides insights into the importance of values analysis. While there is some commensurability and convergence between the value profiles of the various stakeholder groups and the directions governments are now taking with respect to more holistic water management, all stakeholders require greater effort to truly understand and integrate the diversity of values systems. Interview data indicate that government agencies have not yet begun a concerted effort to understand the role of social capital and the moral economy. Furthermore, the vast balance of research and policy development efforts is currently targeted at physical sciences and economics investigations. There is a need for more integrated natural and social sciences research. For example, lessons learned from Canada’s Dust Bowl experience can help us understand the relationship between climate and people (McLeman et al. 2013). Similar insights from Australia emphasize the need for integrative stakeholder-government research combined with adaptive governance approaches to reduce drought risk (Nelson et al. 2008).

Very little research is underway to help institutions and stakeholders better understand and more effectively address divergent or conflicting values systems. As a number of Alberta Environment respondents noted, only brief forays into the valuable role of social sciences and humanities research have been undertaken. Institutions generally agree that it is useful to improve knowledge of the moral economy and social capital, but they lack an understanding of how to apply or integrate this knowledge with physical sciences and economics research. A challenge also exists in applying such integrative knowledge at the local scale, where adaptive

change is most likely to happen. This is one of the fundamental conclusions of this chapter:

A comprehensive approach to investigate climate change impacts and adaptation requires a concerted effort to understand relationships between social and physical sciences, and needs to factor in the role of social capital, the moral economy and place-based interests. Such efforts are needed to balance social, economic and environmental factors, and are necessary for stakeholders and government institutions to develop and implement adequate adaptive responses.

Current watershed planning efforts are steps toward holistic planning, but the efforts of watershed groups are largely “advisory” in nature and “at-arms-length” to government. The efforts of these groups for financial self-sufficiency and integration with formal institutions face many significant challenges that risk the sustainability of these groups (Hurlbert, Corkal, et al. 2009; Hurlbert, Diaz, et al. 2009). Even genuinely inclusive processes cannot substitute for concerted research and leadership into the functioning of social capital, the moral economy, and place-based values by government agencies themselves, which more than any other group, sector, or institution are recognized to be ultimately responsible for protecting the public good and preserving Canada’s environment for present and future generations. In a 2003 study published by Natural Resources Canada, water stakeholders (government representatives and water users) were asked questions about water management, water apportionment, and environmental values (Bruce et al. 2003). The study found a high level of agreement and support for managing water as a community resource, with due considerations for basin-wide interests and water allocations for environmental protection “since the environment cannot defend itself” (Bruce et al. 2003: 133–38). These informants identify a critical role for government in recognizing and addressing diverse values (social, economic, and environmental).

Power differentials among stakeholders may result in those endowed with less power becoming more exposed (lost access to water) or having less capacity (lost economic opportunities). Stakeholders with little power are likely to be more vulnerable to the impacts of climate change. To avoid power asymmetry among stakeholders, conditions must be established to ensure they perceive each other’s concerns and interests as legitimate, regardless of differences in values and interests (Rojas, Magzul, et al. 2009;

Rojas, Reyes, et al. 2009). Using values-analysis profiles can be an effective tool in achieving mutual understanding. Engaging the broad spectrum of stakeholder interests will advance more effective watershed management (e.g., equitable access to water) and reduce stakeholder vulnerability.

This chapter has investigated the potential to use values analysis as a means of addressing existing water conflicts or simply as a means of aiding holistic water management. Figure 2 identifies a simple methodology to construct a stakeholder values analysis, and provides insight on how this approach might be implemented as a decision support tool for use by stakeholders who are dealing with water conflicts, divergent interests, or complex water resource management challenges.

The Intergovernmental Panel on Climate Change (IPCC 2007) identifies potential climate change impacts on systems and sectors, affecting ecosystems, coastlines, water, food production, industry, settlements and society, and human health. In light of the potential social upheavals that drought and other climate change impacts may bring, it would appear ever more pressing to undertake research into the role of stakeholders' values to include elements of social capital, the moral economy, and place-based interests. It will be even more important to find ways to integrate that research with the ongoing physical sciences and economics research on the impacts of climate change. Improving knowledge of values systems and social sciences, combined with natural sciences research, will be critical to resolve conflict and bridge local knowledge with policy makers and programs. Such approaches are also likely to lead to the development of new adaptive governance approaches to address drought and water scarcity (Nelson et al. 2008).

Another important conclusion we draw is that the history of Canadian governance has largely been predicated on the assumptions of a liberal democratic society—that is, the assumption that the individual is primary and that he or she is defined principally as a consumer/producer. But as our results demonstrate, individuals also take much of their identity, meaning, and sense of belonging from the community and the place in which they live. In the Blood Tribe case, the ability to develop and sustain an economic system depends crucially on having a robust moral economy and a system of social capital on which individuals can draw. This is also evident in the agricultural community, as demonstrated by the social upheaval caused by severe multi-year droughts in the 1920s and 1930s. A

Values vary between diverse stakeholders. Contrasting values may lead to opposition or conflict, whereas overly similar group values may lead to imbalanced decisions. Identifying the range of stakeholder values is useful to increase awareness, address conflict, and seek balanced, holistic adaptations. The IACC research mapped water management stakeholder values into four quadrants identified in "Figure 1, The Flower of Values". The motivations of stakeholders were driven by considerations for the "Market" (the economy), "Society" (social/communal), "Autonomy" (individual freedom), and "Place" (local identity and ecology). Generally, the most strongly held or firmly rooted values are depicted the furthest distance from the center of the graphic.

Developing a values map is useful as "a values analysis decision support tool." Values mapping requires input from all vested stakeholders to clearly identify the range of values and motivations for stakeholders (including institutions and policy makers). The values data then need to be categorized, compared, and contrasted in an organized manner, such as the Flower of Values quadrants (Figure 1). In turn, stakeholders can begin to articulate what is at risk for them. Where stakeholder values contrast or are in opposition, further dialogue is required to identify possible common ground.

As a decision support tool, this methodology can be helpful to better understand similarities, differences, and motivations. Such knowledge can help create consensus, manage disagreements, and develop mutual planning approaches. In short, the development of a values mapping graphic is a methodology that allows stakeholders to identify values profiles and differing and potentially conflicting values systems. The knowledge of different values will aid in the resolution of differences and help encourage stakeholder dialogue to find common ground and suitable adaptive responses.

Figure 2. A conceptual "values analysis" decision support tool (or methodology) for water management

more robust economic, social, and environmental balance demonstrated more effective adaptations and more resilient communities.

The ethical dimension of these conclusions can be defined in terms of the relationship between stakeholders and governments. Stakeholders have a trust-based relationship with their governments, which in turn have a fiduciary obligation to protect their stakeholders. More precisely, stakeholders stand as citizens to the governing bodies that they legitimize and empower to make certain kinds of decisions for them. This is to

say that underlying the political relationship is a moral one, as defined by the moral economy and social capital (trust, honesty, sense of belonging, obligations of reciprocity among people and between people and their places). These values are, therefore, integral to the relationship and cannot be viewed as external concerns of governance.

Differences in value orientations (and lack of knowledge of values orientations) can hinder the adoption of successful adaptive practices. How can government institutions better organize and structure themselves to factor contributions from stakeholder groups and citizen groups? To what degree can governments more fully engage local decision makers in ways that allow for accountability and recognize differing values between stakeholders? To what degree can competing interests in water management, water development, economic expansion, individual protection, community sharing, environmental protection, and place-based identity be established as mutual factors that are considered in reconciling conflict or stress and lead to new insights and better adaptations? How will today's decisions help build resilience and strengthen present and future adaptive capacity? What decisions can be made today that are pragmatic and can lead to meaningful action?

To paraphrase one of the respondents, these questions simply emphasize our main point—*values must be considered in the evaluation of climate-induced water stress and society's adaptive responses*. One way to address this is to seek ways to incorporate values analysis in the development of water and climate policies and programs. The conceptual values analysis decision support tool presented in this chapter may be used a methodology for identifying values systems of diverse stakeholders, including institutions and policy makers. Values analysis will be helpful for stakeholders to better understand differing positions, to address real or perceived conflicts, and to implement improved adaptive responses for strengthening local capacity and an overall more resilient society.

Acknowledgments

This chapter is primarily based on one element of a much broader interdisciplinary research project conducted within Canada's South Saskatchewan River basin (SSRB) in Saskatchewan and Alberta. During the period from 2004 to 2009, natural and social science research investigated

vulnerabilities and adaptations to climate-induced water stress in the semi-arid region, which is heavily reliant on agricultural production. The study, *Institutional Adaptations to Climate Change*, was conducted both in the SSRB watershed in Canada and the Rio Elqui watershed in Chile, with \$2.43 million in funding provided by the Social Sciences and Humanities Research Council of Canada. More information on the research may be found at <http://www.parc.ca/mcri/>.

NOTES

- 1 The term “values analysis” derives in part from the concept of “values mapping” (Cragg 1997).
- 2 Bourdieu (1986) states “social capital” is “a durable network of more or less institutionalized relationships of mutual acquaintance and recognition—or in other words, to membership in a group.” For example, earned trust is an intangible resource that people draw on when attempting to satisfy an activity that requires the co-operation of others. Familial obligation is another example that people draw on, particularly during times of need or stress. Portes (1998) states that social capital is “the ability of actors to secure benefits by virtue of membership in social networks or other social structures.” Putman (1995) defines social capital as “features of social organization such as networks, norms, and social trust that facilitate coordination and co-operation for mutual benefits.” Some individuals and communities in southwestern Saskatchewan and the Special Areas of Alberta demonstrated stronger social capital assets than others and were recognized as having greater capacity to work together to address drought and climate risks. See Warren and Diaz (2012) and Magzul (2013).
- 3 “Moral economy” relates to the normative orientation that people bring to their social interactions (e.g., debts owed due to past sacrifices of others, exchanges of trust between people and groups, inclusion and recognition within a group, goodwill or malice, sense of fairness and justice, responses of appreciation or resentment toward those who “deserve” such responses, honour and trustworthiness, respectability). The main sources of the concept of moral economy are derived from Perry (1909), Thompson (1971), Scott (1976), Adger (1998, 2001), and Morito (2012). The moral economy places value on characteristics such as social relations, quality of life, fairness and equity, a healthy environment, or other such characteristics not normally considered by conventional principles of market economies. The term moral economy has been used to counter tendencies to use reductive explanatory frameworks in history and other disciplines (Scott 1976).

- 4 Cantin (2010) describes “place-based approaches” as policies and programs that address complex socio-economic issues in a collaborative manner (i.e., with the contributions of multiple stakeholders) and by targeting activities and interventions at a specific geographic scale. This quadrant in the Flower of Values (see Figure 1) identifies stakeholder values for their “local place.”
- 5 The document *The Oldman River Dam Conflict: Adaptation and Institutional Learning* describes in part how conflict and power differentials are factors that can actually impair a community’s capacity to participate in consultations and reduce the potential of adapting to climate stress. (Rojas, Magzul, et al. 2009; Magzul 2013)
- 6 The Saskatchewan Water Security Agency was created in 2012; it was formerly the Saskatchewan Watershed Authority, which existed from 2002–12).
- 7 The Prairie Farm Rehabilitation Administration (PFRA) was created in 1935 and was a branch of Agriculture and Agri-Food Canada (AAFC). The PFRA evolved into a national agency in 2009 named the Agri-Environment Services Branch (AESB); it existed until 2012. In July 2012, AAFC’s AESB and Research Branch were merged together to form one branch named the Science and Technology Branch.

References

- Adger, W.N. 1998. “Observing Institutional Adaptation to Global Environmental Change: Theory and Case Study from Vietnam.” Global Environmental Change Working Paper 98-21, Centre for Social and Economic Research on the Global Environment, University of East Anglia and University College London.
- . 2001. “Scales of Governance and Environmental Justice for Adaptation and Mitigation of Climate Change.” *Journal of International Development* 13: 921–31.
- . 2006. “Vulnerability.” *Global Environmental Change* 16: 268–81.
- Alberta Environment. 2003. *Water for Life: Alberta’s Strategy for Sustainability*. <http://www.waterforlife.alberta.ca/>. Accessed 27 September 2013.
- . 2008. *Water for Life: A Renewal*. <http://www.waterforlife.alberta.ca/>. Accessed 27 September 2013.
- Banks, T., and E. Cochrane. 2005. *Water in the West: Under Pressure*. Fourth Interim Report of the Standing Senate Committee on Energy, the Environment and Natural Resources. Ottawa: Parliament of Canada. <http://www.parl.gc.ca/Content/SEN/Committee/381/enrg/rep/rep13nov05-e.htm>. Accessed 30 September 2013.
- Batie, S.S. 2008. “Wicked Problems and Applied Economics.” *American Journal of Agricultural Economics* 90, no. 5: 1176–91.

- Bourdieu, P. 1986. "The Forms of Capital." Pp. 241–58 in J. Richardson (ed.), *Handbook of Theory and Research for the Sociology of Education*. New York: Greenwood Press.
- Bruce, J.P., H. Martin, P. Colucci, G. McBean, J. McDougall, D. Shrubsole, J. Whalley, R. Halliday, M. Alden, L. Mortsch, and B. Mills. 2003. *Climate Change Impacts on Boundary and Transboundary Water Management*. CCAF Project A458/402. Ottawa: Natural Resources Canada. http://www.researchgate.net/publication/273561792_Climate_Change_Impacts_on_Boundary_and_Transboundary_Water_Management. Accessed 2 December 2015.
- Bruneau, J., D.R. Corkal, E. Pietroniro, B. Toth, and G. van der Kamp. 2009. "Human Activities and Water Use in the South Saskatchewan River Basin." Pp. 129–52 in G. Marchildon (ed.), *A Dry Oasis: Institutional Adaptations to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- Cantin, B. 2010. "Integrated Place-Based Approaches for Sustainable Development." *Horizons: Sustainable Places* 10, no. 4. Ottawa: Policy Research Initiative.
- Clark, W., and L. Holliday (rapporteurs). 2006. *Linking Knowledge with Action for Sustainable Development: The Role of Program Management*. Workshop Summary, Roundtable on Science and Technology for Sustainability Policy and Global Affairs. National Research Council of the National Academies. Washington, DC: National Academies Press.
- Corkal, D.R., and P.E. Adkins. 2008. "Canadian Agriculture and Water." In *Proceedings of the 13th IWRA World Water Congress*. Montpellier, France, 1–4 September 2008.
- Corkal, D.R., P.E. Adkins, and B. Inch. 2007. "The Case of Canada—Institutions and Water in the South Saskatchewan River Basin." Working paper from Institutional Adaptation to Climate Change research project, University of Regina. http://www.parc.ca/mcri/paper_browse.php. Accessed 27 September 2013.
- Corkal, D.R., H. Diaz, and D. Sauchyn. 2011. "Changing Roles in Canadian Water Management: A Case Study of Agriculture and Water in Canada's South Saskatchewan River Basin." *International Journal of Water Resources Development* 27, no. 4: 647–64.
- Corkal, D.R., W.C. Schutzman, and C.R. Hilliard. 2004. "Rural Water Safety from the Source to the On-farm Tap." *Journal of Toxicology and Environmental Health, Part A* 67: 1619–42.
- Cragg, W. 1997. "Value Mapping Workshop." Toronto, Ontario, 15–17 October 1997.
- Diaz, H., M. Hurlbert, J. Warren, and D.R. Corkal. 2009. *Saskatchewan Water Governance Assessment Final Report*. Institutional Adaptation to Climate Change Research Project. Regina: University of Regina. <http://www.parc.ca/mcri/pdfs/papers/gov01.pdf>. Accessed 27 September 2013.
- Global Water Partnership. n.d. Global Water Partnership website: <http://www.gwp.org>. <http://www.gwpforum.org/servlet/PSP?iNodeID=1345>. Accessed 8 October 2009.
- Gray, J.H. 1967. *Men Against the Desert*. Winnipeg: Burton Lysecki Books.

- Hurlbert, M., D.R. Corkal, and H. Diaz. 2009. "Government and Civil Society: Adaptive Water Management in the South Saskatchewan River Basin." Pp. 181–207 in G. Marchildon (ed.), *A Dry Oasis: Institutional Adaptations to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- Hurlbert, M., H. Diaz, D.R. Corkal, and J. Warren. 2009. "Climate Change and Water Governance in Saskatchewan, Canada." *International Journal of Climate Change Strategies and Management* 1, no. 2: 118–32.
- IPCC (Intergovernmental Panel on Climate Change). 2007. "Climate Change 2007 Synthesis Report." IPCC Plenary XXVII, Valencia, Spain, 12–17 November 2007.
- IRC (International Reference Centre for Community Water Supply). 2009. International Reference Centre for Community Water Supply (IRC) website: <http://www.ircwash.org/home>; Source cited: <http://www.irc.nl/page/10433>. Accessed 8 October 2009.
- Magzul, L. 2013. "Vulnerability and Adaptation to Climate Change in Indigenous Communities in Canada and Guatemala: The Role of Social Capital." PhD dissertation, University of British Columbia.
- Marchildon, G.P. (ed.). 2009a. *A Dry Oasis: Institutional Adaptation to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- . 2009b. "The Prairie Farm Rehabilitation Administration: Climate Crisis and Federal-Provincial Relations during the Great Depression." *Canadian Historical Review* 90, no. 2: 275–301.
- Marchildon, G., S. Kulshreshtha, S.E. Wheaton, and D. Sauchyn. 2008. "Drought and Institutional Adaptation in the Great Plains of Alberta and Saskatchewan: 1914–1939." *Natural Hazards* 45, no. 3: 391–411.
- McLeman, R.A., J. Dupre, L. Berrang Ford, J. Ford, K. Gajewski, and G. Marchildon. 2013. "What We Learned from the Dust Bowl: Lessons in Science, Policy, and Adaptation." *Popular Environment*. doi: 10.1007/s11111-013-0190-z.
- Morito, B. 2005. *Value and Ethical Analysis in Vulnerability to Climate Change: Establishing an Analytic Framework for Identifying, Classifying and Evaluating Vulnerability Issues*. Institutional Adaptation to Climate Change Research Project. Regina: University of Regina <http://www.parc.ca/mcri/pdfs/papers/iacc017.pdf>.
- . 2008. *Institutional Values and Adaptive Capacity to Climate Change*. Institutional Adaptation to Climate Change Research Project. Regina: University of Regina. <http://www.parc.ca/mcri/pdfs/papers/iacc085.pdf>.
- . 2008a. Ibid, citing respondents ATH7, ALB9, ALB10.
- . 2008b. Ibid, citing respondent ALB10.
- . 2008c. Ibid, citing respondent ALB9.
- . 2008d. Ibid, citing respondent ALB2.
- . 2012. *An Ethic of Mutual Respect: The Covenant Chain and Aboriginal-Crown Relations*. Vancouver: UBC Press.
- Morito, B., and A. Thachuk. 2008. *Values Analysis of Ethnographic Stakeholder Responses: Report on Cabri-Stewart Valley and the Blood Reserve for the IACC*

- Project, Section 1A. Institutional Adaptation to Climate Change Research Project.* Regina: University of Regina: <http://www.parc.ca/mcri/pdfs/papers/iacc065.pdf>.
- Nelson, R., M. Howden, and M. Stafford Smith. 2008. "Using Adaptive Governance to Rethink the Way Science Supports Australian Drought Policy." *Environmental Science & Policy* 11, no. 7: 588–601.
- Nicole, L.A., and K.K. Klein. 2006. "Water Market Characteristics: Results from a Survey of Southern Alberta Irrigators." *Canadian Water Resources Journal* 31, no. 2: 91–104.
- Patiño, L., and D. Gauthier, 2009. "A Participatory Mapping Approach to Climate Change in the Canadian Prairies." Pp. 79–92 in G. Marchildon (ed.), *A Dry Oasis: Institutional Adaptations to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- Perry, R.B. 1909. *The Moral Economy*. New York: Charles Scribner's Sons.
- Portes, A. 1998. "Social Capital: Its Origins and Applications in Modern Sociology." *Annual Review of Sociology* 24: 1–25.
- Putnam, R.D. 1995. "Bowling Alone: America's Declining Social Capital." *Journal of Democracy* 6: 65–78.
- Rojas, A. 2000. "Land Food and Community I. Course Manual, Agricultural and Environmental Ethics." Course: AGSC 250, Faculty of Agricultural Sciences, University of British Columbia.
- Rojas, A., L. Magzul, G.P. Marchildon, and B. Reyes. 2009. "The Oldman River Dam Case Study: Conflict, Adaptation and Institutional Learning." *Prairie Forum* 34, no. 1: 235–60. Also published as pp. 235–60 in G. Marchildon (ed.), *A Dry Oasis: Institutional Adaptations to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- Rojas, A., B. Reyes, A. Magzul, E. Schwartz, R. Bórquez, and D. Jara. 2009. *Living Waters: What Commitment Is Needed from Institutions in the Era of Climate Change? Support Manual for an Adaptive Resolution to Environmental Conflicts*. Published in the same book in Spanish as: *Aguas de la vida: manual de apoyo*. Regina: Canadian Plains Research Center Press. <http://www.parc.ca/mcri/books.php>. Accessed 2 October 2013.
- Rojas, A., and L. Richer. 2005. "Successful Institutional Adaptations to Climate Change Impacts Posed on Water Resources." IACC Project Working Paper No. 18, University of British Columbia. <http://www.parc.ca/mcri/>.
- Saskatchewan Watershed Authority. 2002. *Annual Report 2002*. Moose Jaw: Saskatchewan Watershed Authority. <http://www.swa.ca/Publications/Documents/SwaAnnualReport2002.pdf>. Accessed 8 October 2009.
- Saskatchewan Water Security Agency. 2012. *25 Year Saskatchewan Water Security Plan*. Moose Jaw, Saskatchewan Water Security Agency. <https://www.wsask.ca/About-WSA/25-Year-Water-Security-Plan/>. Accessed 27 September 2013.
- Sauchyn, D., H. Diaz, and S. Kulshreshtha (eds.). 2010. *The New Normal: The Canadian Prairies in a Changing Climate*. Regina: Canadian Plains Research Center Press.

- Scott, J. 1976. *The Moral Economy of the Peasant*. New Haven: Yale University Press.
- Swinton, S.M. 2008. "Reimagining Farms as Managed Ecosystems." *Choices* 23, no. 2. American Agricultural Economics Association.
- Thompson, E.P. 1971. "The Moral Economy of the English Crowd in the Eighteenth Century." *Past and Present* 50: 76–136.
- Toth, B., D.R. Corkal, D. Sauchyn, G. van der Kamp, and E. Pietroniro. 2009. "The Natural Characteristics of the South Saskatchewan River Basin." Pp. 95–127 in G. Marchildon (ed.), *A Dry Oasis: Institutional Adaptations to Climate on the Canadian Plains*. Regina: Canadian Plains Research Center Press.
- Warren, J., and H. Diaz. 2012. *Defying Palliser: Stories of Resilience from the Driest Regions of the Canadian Prairies*. Regina: Canadian Plains Research Center Press.
- Wheaton, E., S. Kulshreshtha, V. Wittrock, and G. Koshida. 2008. "Dry Times: Hard Lessons from the Canadian Drought of 2001 and 2002." *The Canadian Geographer* 52, no. 2: 241–62.
- Wheaton, E., V. Wittrock, S. Kulshreshtha, G. Koshida, C. Grant, A. Chipanshi, and B. Bonsal. 2005. *Lessons Learned from the Canadian Drought Years of 2001 and 2002: Synthesis Report*. Saskatoon: Saskatchewan Research Council.
- World Meteorology Organization. 1992. *The Dublin Statement on Water and Sustainable Development*. Geneva: World Meteorology Organization. <http://www.wmo.int/pages/prog/hwrrp/documents/english/icwedece.html>. Accessed 8 October 2009.

BRIDGING KNOWLEDGE SYSTEMS FOR DROUGHT PREPAREDNESS: A CASE STUDY FROM THE SWIFT CURRENT CREEK WATERSHED (CANADA)

*Jeremy Pittman, Darrell R. Corkal, Monica Hadarits,
Tom Harrison, Margot Hurlbert, and Arlene Unvoas*

Introduction

Every year droughts have significant impacts around the globe. These impacts cascade through social-ecological systems, meaning that even localized droughts can have global significance in today's highly interconnected world. Despite the visibility of its effects, drought remains one of the most enigmatic disasters or climate-related disturbances, eluding even a broadly accepted definition.

As with most extreme events, it is typically better to address drought risk proactively, through preparedness planning, rather than solely reacting to drought events. Wilhite (2005, 1996) has demonstrated the benefit of drought preparedness in a number of contexts. Benefits from preparedness are derived from reduced stress on the system, improved ability to

make decisions during crises, and lower costs associated with proactive adaptation—all aspects that help reduce the vulnerability of society in general and the rural population in particular. However, preparedness is not a panacea, and it must be accompanied by a suite of reactive adaptation strategies to be effective.

This chapter explores how deliberative, watershed-scale drought preparedness planning fits within broader adaptation strategies and programs in a case study of the Swift Current Creek watershed in Canada. The chapter begins with an overview of the conceptual framework that guided the research and follows with a detailed description of the case study. It then presents the methods used to explore the case and subsequently highlights the main results. Finally, the results are discussed in light of their implications for our understanding of multi-stakeholder, deliberative processes for drought preparedness, and conclusions are presented on the value of working with multiple and diverse stakeholders to bridge knowledge for drought preparedness.

Conceptual Framework

Human adaptation to climate is defined as “the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities” (IPCC 2012: 5). We see preparedness as a specific type of proactive adaptation, where actors anticipate options and become “ready to respond ... and manage ... consequences through measures taken prior to an event” (MREM 2011: 4). Preparedness is somewhat synonymous with what Smit et al. (2000) refer to as anticipatory and planned adaptation in that preparedness is deliberately undertaken prior to a potentially problematic climate event. Preparedness occurs in the context of uncertainty, meaning that actors must prepare with incomplete knowledge of the severity, magnitude, timing, and frequency of future events.

Berkes (2009) has shown how processes that engage knowledge from different sources (e.g., scientists, agricultural producers, different sector and industry groups, environmental groups, communities and social groups) can help navigate uncertainty. Here, uncertainty is conceptualized as an irreducible property of social-ecological systems. Social-ecological systems are inherently linked, co-dependent, and co-evolutionary

systems comprised of social and ecological dimensions (Berkes and Folke 1998). The rationale for drawing on diverse knowledge to confront such uncertainty in social-ecological systems is to broaden active participation and the breadth of information used in decision making.

Bridging is the process of bringing different knowledge systems together to address problems that are relevant to different groups (Bohensky and Maru 2011). Bridging brings knowledge systems together in ways that maintain the integrity of each system (Reid et al. 2006), and knowledge is translated between actors without coercion (Sundberg 2007). Knowledge-bridging processes can be facilitated using boundary objects (Cash et al. 2003), which are objects that can take many forms (e.g., maps, models, concepts) and allow for knowledge communication and translation between actors with different understandings, interpretations, and interests associated with common problems (Brand and Jax 2007; Star and Griesemer 1989). Boundary objects must be flexible and adaptable to distinct contexts and situations. In this case study, a number of boundary objects were used to bridge knowledge for drought preparedness in the Swift Current Creek watershed.

Overview of the Swift Current Creek Watershed

The Swift Current Creek watershed is located in southwestern Saskatchewan, which is a relatively dry region of the Canadian Prairies (Figure 1). As part of the Palliser Triangle, the watershed has experienced recurring severe droughts over the last century. Some of the most notable droughts occurred in the 1930s, 1960s, 1980s, and 2000s, each having significant implications for agricultural production in the watershed (SRC 2011).

The watershed encompasses a total drainage area of 5,592 km². It begins near the Cypress Hills in Saskatchewan and continues to the creek's outlet on the South Saskatchewan River near Stewart Valley (Figure 1). The watershed contains mostly agricultural land and a number of rural communities. There are 5 urban municipalities (UMs) in the watershed, Swift Current and Shaunavon being the largest, and 12 rural municipalities (RMs).

The Swift Current Creek is supplied by snowmelt runoff and a number of groundwater springs. It flows about 160 km from its headwaters, contributing water into the South Saskatchewan River, which ultimately

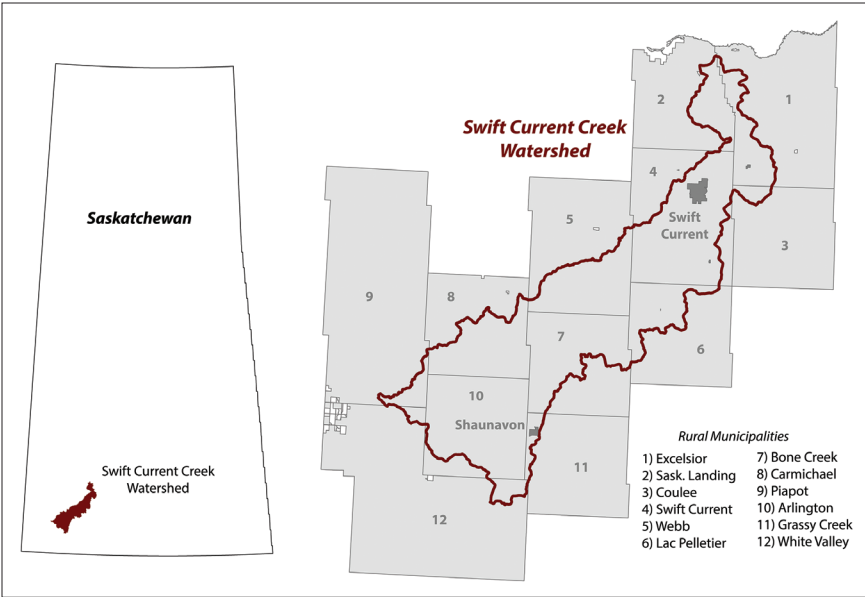


Figure 1. Map of the Swift Current Creek watershed, Saskatchewan

drains into Hudson Bay. The creek provides several services within the Swift Current Creek watershed, such as water for agricultural production (irrigation and livestock), municipal drinking water supplies, and recreation. Developed in 1943, the Duncairn Dam and Reid Lake Reservoir provide some drought protection within the watershed. This infrastructure stores 105,000 dam³ of water at its full supply level, which supports 7,000 ha of irrigated agricultural land and provides a dependable water supply for the city of Swift Current.

The Swift Current Creek Watershed Stewards (SCCWS), a not-for-profit corporation officially created in 2001, has sought to maintain or improve watershed health since it was organized (Table 1). In 2007, the SCCWS partnered with the Saskatchewan Watershed Authority (now the Water Security Agency), a provincial Crown corporation mandated to manage water in Saskatchewan, to implement a source water protection planning process. This process was part of a broader provincial initiative called the Long Term Safe Drinking Water Strategy, one component of

Table 1. Timeline of milestones and successes for the Swift Current Creek Watershed Stewards (SCCWS)

Year(s)	Description	Key successes
1998	The City of Swift Current voices concerns over increased water treatment costs at its water treatment plant. Agriculture and Agri-Food Canada's Prairie Farm Rehabilitation Administration is tasked with testing water quality; it is determined that there is no obvious decrease in water quality.	<ul style="list-style-type: none"> Completed a four-year watershed monitoring project Worked with many producers to promote beneficial management practices that protect water supplies within the watershed Established an effective working relationship with urban and rural municipalities, as well as diverse stakeholders within the watershed Created awareness of an invasive species (salt cedar) that was entering the watershed from the United States; in response to a SCCWS flyer on the issue, a stakeholder identified the first salt cedar plant in Saskatchewan and measures began to control this invasive species Developed strong working relationships with various government agencies (local, provincial, federal) Participated in the Southwest Public Safety Region pilot project to help prepare for emergencies Worked with partners on academic research (e.g., Vulnerability and Adaptation to Climate Extremes in the Americas project) to better understand climate risks and adaptation options in the watershed
1999	An accidental release of raw effluent from the city of Swift Current's lagoons flows into Swift Current Creek. A group of concerned stakeholders, representing the interests of various federal, provincial, and municipal agencies, gathers to discuss various watershed issues, such as effluent releases into the creek and sewage flowing into Lac Pelletier.	
2001	The City of Swift Current is fined \$25,000 for the effluent release, with the stipulation that the fine be used to form a creek stewardship group. The City agrees to pay \$5,000 per year for five years. The stewardship group is officially formed and becomes incorporated as the SCCWS.	
2002	The SCCWS applies for and receives funding to hire a watershed coordinator. As the group meets, a decision is made to educate water users and other stakeholders within the watershed about water quality and quantity issues and impacts.	
2006	The SCCWS is invited to apply for Agri-Environmental Group Plan funding under the Federal-Provincial Agriculture Policy Framework. SCCWS receives funding to increase awareness of agri-environmental risks in the watershed and begins planning to address these risks.	
2007	The Saskatchewan Watershed Authority asks the SCCWS to develop a source water protection plan.	
2009	SCCWS completes a source water protection plan.	
2010–15	The SCCWS (13 members) continues to operate as a non-profit watershed group and seek opportunities and funding to enhance the watershed's environment, economy, and social systems.	

Table 2. Recommendations and actions related to drought preparedness from the *Swift Current Creek Watershed Protection Plan*

Recommendations	Actions
Research the impact of climate change on water supply, including the variability in flow regimes in the creek, and develop mitigation strategies	Develop adaptation strategies to deal with natural climate variability and cyclical flow regimes in Swift Current Creek
	Determine/estimate extreme cyclical variations and how best to manage them
	Use historical events to better understand and quantify future events
Research and implement measures for drought preparedness, including organization of a drought preparedness workshop	Develop water supply availability information, including surface water and groundwater; identify communities at risk; and organize a drought preparedness workshop

Source: SCCWS 2009.

which was aimed at producing community-based source water protection plans in a number of Saskatchewan’s watersheds. These plans were to be produced collaboratively with multiple watershed stakeholders.

In 2009, the *Swift Current Creek Watershed Protection Plan* was completed (SCCWS 2009). The plan contained 62 recommended action items aimed at improving sustainability in the Swift Current Creek watershed and identified different ways that stakeholders and organizations across different governance levels (i.e., local, regional, provincial, federal) could work together to achieve the desired outcomes. The result was two main recommendations, and four subsequent actions, directly related to drought preparedness (Table 2). These recommendations and actions included different elements of stakeholder engagement, adaptation planning, and hydro-climate analysis, and were to be implemented by the SCCWS, the Saskatchewan Watershed Authority, the Saskatchewan Ministry of Agriculture, and Agriculture and Agri-Food Canada.

Methods for Drought Preparedness Planning

In early 2010, a drought preparedness planning project was initiated in the Swift Current Creek watershed to address the recommendations and action items in the *Swift Current Creek Watershed Protection Plan*. The project used a participatory action research (PAR) approach to bridge knowledge systems during development of the plan. PAR is a combination of participatory research, which is research that explicitly includes and engages stakeholders throughout the research process (Cargo and Mercer 2008), and critical action research, which is research undertaken with the intent of producing beneficial outcomes for stakeholders (Kemmis and McTaggart 2000). Rather than a method in itself, PAR is an approach to research that guides the use of a broad range of methods. As such, the specific methods used in PAR can span both qualitative and quantitative inquiry (Cargo and Mercer 2008), as well as draw from both the natural and social sciences (Ravera et al. 2011). PAR is a proven successful technique for bridging knowledge between different groups throughout a research project (Whitfield and Reed 2012).

This project was to be implemented collaboratively between the SC-CWS and the Saskatchewan Watershed Authority, but it required the involvement of other stakeholder groups, government organizations, and research groups. These additional organizations were either engaged directly in the planning process or contributed specific pieces of work or studies that informed the planning process. Other organizations engaged in the planning process included the Southwest Enterprise Region, the Saskatchewan Ministry of Agriculture, the Saskatchewan Ministry of Municipal Relations (formerly Municipal Affairs), Agriculture and Agri-Food Canada through its Agri-Environment Services Branch, the Prairie Adaptation Research Collaborative (PARC), and the Saskatchewan Research Council (SRC). These different groups were engaged during workshops, and many completed complementary studies that were used throughout the planning exercise (see the Acknowledgments). Most specifically, PARC conducted hydro-climate variability assessments and projections (Barrow 2011; St. Jacques et al. 2011; PARC 2010), and SRC completed extreme events characterizations (SRC 2011) that were used in the planning process.

The inclusion of these diverse groups and stakeholders required that knowledge be bridged across a number of boundaries. At the local level, there were participants involved with different modes of agricultural production, including both dryland and irrigation producers of crops, forage, and livestock. Other local-level participants included UMs and RMs, as well as additional community groups (e.g., Southwest Enterprise Region). At the provincial and federal levels, several different agencies were involved, each with different expertise (see above). Knowledge held by these agencies ranged from scientific knowledge regarding hydrology and agrology to more pragmatic knowledge regarding agricultural extension or program and policy development. In addition, climatological knowledge and expertise were provided by PARC and SRC.

The knowledge-bridging process involved two main components: a participatory vulnerability assessment and a participatory adaptation planning exercise. The vulnerability assessment aimed to understand how and why past droughts had been problematic and identify the variety of different adaptation options used to deal with past droughts. In addition, potential vulnerabilities and adaptation options for future droughts were explored. The vulnerability assessment provided the foundation for the adaptation planning exercise, which aimed to identify strategies that could increase preparedness to future droughts in light of existing and potential vulnerabilities. Three main boundary objects were used to bridge knowledge from diverse sources throughout the project: maps, timelines, and scenarios. The utility of these boundary objects has been demonstrated elsewhere (Ravera et al. 2011; Kok et al. 2007), but their applicability in the context of drought preparedness planning in Saskatchewan watersheds was untested prior to completion of this case study.

Outcomes of the Bridging Process

The knowledge-bridging process resulted in a number of outcomes. Most importantly, it facilitated the development of in-depth insights into current and future drought vulnerability within the watershed and provided the foundations for adaptation planning. These insights and outcomes are discussed below in relation to the boundary objects and bridging processes that facilitated the research.

Participatory Mapping and Timeline Construction

The participatory mapping and timeline exercises, using both maps and timelines as boundary objects, allowed participants to discuss the spatial and historical elements of drought vulnerability in the watershed. These exercises provided insights into the long history of the watershed's agricultural sector in dealing with drought (Table 3) and the lessons learned throughout the course of this history. For example, participants discussed how the tillage practices of the 1930s had increased agricultural vulnerability to drought and how significant progress toward soil conservation had been made in the watershed since then (see Chapter 5 by Warren on min till in this volume). Additionally, participants identified a number of beneficial policy and practice cycles, such as water development projects that constructed farm dugouts in the 1980s or the promotion of shallow-buried pipelines in the late 1990s, which significantly reduced agricultural sensitivity and increased preparedness for droughts.

The mapping exercise identified different locations in the watershed that were more or less sensitive to drought and excessive moisture. Also, the locations of key events were recorded in ways that complemented the timeline activity. The mapping exercise provided some interesting insights into different biophysical vulnerabilities in the watershed as well, such as how certain fish populations can become trapped in deep pools along the Swift Current Creek when streamflow is low. Arguably, the mapping activity was the most successful of all the exercises, largely because it gave participants an opportunity to visualize issues and sparked valuable engagement between the different stakeholders.

Participatory Scenarios

Scenarios were an additional boundary object used during the planning process (Table 4). The scenarios were developed based on findings from complementary studies (see the Acknowledgments) and focus group discussions aimed at understanding vulnerabilities. These scenarios were framed as “what if” questions and were developed to represent a range of possibilities related to dry and wet conditions in the watershed. More specifically, these scenarios explored the vulnerabilities and adaptation options under extreme events of different intensity, duration, and frequencies. They also stimulated discussion of existing and potential vulnerabilities and adaptation options.

Table 3. Timeline of important events related to drought preparedness in the Swift Current Creek watershed

Period/Year	Description
1930	Plow and thrasher era; no straw; soil pulverized
1950s	Irrigation development; flooding of flat land; alkali issues
1951	Duncairn Dam almost washed away by flood
1952	The community of Eastend almost washed away by flood
1950s–60s	Widespread drought; trees and shelterbelts planted to catch snow and reduce wind erosion
1970	Heavy snowfall; many calves lost
1976	Cattle walking over corrals because of high snow levels
1978	May – five-day blizzard
1982	May 25 – 1.5 feet of snow; blizzard
1988	Very dry; PFRA dugout program expanded and many dugouts built during this severely dry year
1991	Very wet; two to three inches of rain in spring
1996	Wet winter snow
1997	Large flooding in spring due to rapid thaw; Gravelbourg almost flooded out
1999	Introduction of PFRA shallow pipelines for livestock
2000	Rained approximately 13 inches within 14 hours in Vanguard area; water diverted into Old Wives basin
2001	Widespread drought
2002	Minimal moisture until July; rained hard in August
2005	Improvements in watering techniques to exclude livestock access: fencing of dugouts and using solar-powered and remote watering systems
2007	Duncairn Dam spillway taxed with inflow from a large snowmelt runoff and a rapid spring thaw
2008	Very few sloughs in spring
2010	A record dry winter and spring, followed by an excessively wet summer; beginning in July, dugouts fill, watercourses flow, and soil and land become waterlogged in areas of high rainfall
2010	The town of Maple Creek and surrounding area receive record flooding following intense short-duration rains. A portion of the Trans-Canada Highway infrastructure is washed out. Junction Dam, immediately upstream of the highway, survives the flood, largely because spillway capacity was increased in 2008 to safeguard the dam for larger flows and flood events.

Note: PFRA = Prairie Farm Rehabilitation Administration.

A number of interesting insights were gained from the participatory scenario process.

First, participants highlighted the need for long-term programming to reduce sensitivities and increase adaptive capacities to extreme events, rather than short-term programs or ad hoc responses aimed at coping with events already occurring. This discussion emerged during Scenario A, somewhat in response to excess moisture conditions being experienced during the time of the workshops.

Second, participants noted the challenges associated with adaptation to drought in the watershed and stated that the successes and failures of past adaptation strategies would have significant implications for future drought vulnerabilities. This discussion largely emerged during Scenario B. For example, the irrigation development in the watershed during the 1950s had not necessarily produced the benefits that were intended, such as the production of irrigated, high-value crops in the watershed. The irrigation infrastructure does provide important access to water for crops and forage in times of drought, but these crops and forage are typically of low economic value. At the time of the workshops, much of this infrastructure was publicly owned and required significant maintenance and investment to remain operational. The broad public benefit of this investment had been brought into question, along with the monetary value to the local economy actually added by the irrigation system. As such, the federal government was in the process of divesting the irrigation infrastructure to local groups (see Chapter 6 by Warren on irrigation in this volume). Participants noted how some sub-projects within the irrigation system would probably be sustained under local operation, but many were at risk of being decommissioned. This provided an interesting element to the scenario discussions in that irrigation expansion was not a major theme. Rather, program and policy strategies that promoted small-scale infrastructure investments (e.g., shallow buried pipelines for livestock watering) and improved agronomic practices (e.g., soil conservation) were favoured.

Third, participants viewed increased inter-annual hydro-climate variability as less problematic than longer-term drought or increased frequency of excessive moisture events (Scenario C in Table 4). As such, adaptation options recommended for increased inter-annual variability were similar to those already implemented in the watershed. Participants

Table 4. Participatory assessment of vulnerability and adaptation under the different scenarios

Scenario	Vulnerability	Adaptation
Scenario A: What would happen if a wet year like 2010 happened twice in five years?	<ul style="list-style-type: none"> • Problems with hay quality • Stressful: long haying season • Rural areas more affected than urban areas • Ranchers may be better able to handle the rain—grass acts as a buffer; hay quality decreases and quantity increases • Timing of rain depends on impact and vulnerability • Silage companies difficult to hire • Cities would require increased budgets for repairs and snow removal (e.g. heaving sidewalks). • Large-scale economic problems • Timing a major concern • Poor-quality crops 	<ul style="list-style-type: none"> • Change calving cycle • Stockpile feed • Ranchers may need to test hay and buy protein blocks. • Use more inoculants (i.e., \$5/bale, which is less expensive than silage) • 8+ tonnes hay per acre – could afford to do silage • Start seeding earlier • Learn how to grow rice • Producers need more control of marketing (CWB, options for cattle) • Keep off-farm jobs • Need programs aimed at long-term solutions rather than short-term fixes • Resentment results when some rural municipalities receive relief but others do not.

Scenario B: What would happen if a long-term drought (lasting longer than previously experienced) occurred?	<ul style="list-style-type: none"> • Price increase could influence stocking rates. • Irrigators – rely on water • Ranchers may not have enough water to maintain grazing on native pasture. • Ranchers may sell some of their herd, which forces them to risk decreasing the quality of their herds' genetics. • Cattle will not walk one mile for water so must haul water • Overgrazing 	<ul style="list-style-type: none"> • Ideally, stockpile two years' supply of hay before the droughts occur • Defer grazing and use grazing management system • Haul cattle to other areas of Saskatchewan and Manitoba to graze • Construct more water storage (farm dugouts) • Increase reservoir storage and dam size • Sell part of herd • Use a variety of feeds • AAFC divestiture of irrigation projects will mean new adaptive responses are required by local operators. • Stakeholders view southwestern Saskatchewan as well-adapted and fairly drought-proof (e.g.: pipelines, irrigation projects, dugouts, soil conservation).
Scenario C: What would happen if drought and excessive moisture events switched back and forth from wet to dry years very quickly?	<ul style="list-style-type: none"> • Longer duration is more devastating than high frequency. • Vulnerability depends on the stage of your career. • Markets dictate what happens. 	<ul style="list-style-type: none"> • Plan for normal precipitation • Have two-year supplies of water and hay available • Use frugal management • Maintain cropping practices – large-scale change does not occur • Need improved lead-time on climate forecasts

Source: SCCWS 2009.

Note: CWS = Canadian Wheat Board; AAFC = Agriculture and Agri-Food Canada.

did highlight that vulnerability would largely depend on the response of international commodity markets to this variability and noted that frugal management of financial and environmental resources would be required. In addition, participants noted how vulnerability to increased variability largely depends on agricultural producers' stage of career, with established producers less vulnerable than younger producers, since they typically have less debt.

Adaptation Planning and Prioritizing Actions

The adaptation planning and prioritization workshop followed the participatory mapping, timelines, and scenario exercises, and aimed to bridge diverse stakeholder knowledge in the co-production of a drought preparedness plan. During this workshop, participants were presented with synthesized findings related to vulnerability and adaptation from the first workshop and subsequently asked to develop adaptation strategies that could help address these vulnerabilities. In addition, participants were presented with information from studies by SRC that characterized extreme climate events to facilitate the planning and knowledge-bridging activities.

The exercises resulted in the development of adaptation strategies aimed at the municipal and agricultural sectors (Table 5). Strategies varied from those focused mostly on infrastructure (e.g., build redundancy into municipal water supply systems) to those focused on capacity-building approaches (e.g., provide training for municipal staff on emergency management). Many of the strategies related to modifying existing practices (e.g., define drought triggers for different levels of response), developing better climate information systems (e.g., increase number of climate observation stations), and then integrating these systems with decision making (e.g., base relief programs partly on reliable climate science).

Discussion: Opportunities and Challenges

Although many of the strategies listed in Table 5 are justifiable and have potential net benefits, several opportunities and challenges have been associated with implementation. This project bridged knowledge from diverse stakeholders while preparing the plan and built a core group of collaborators for implementing drought preparedness projects in the

Table 5. Adaptation strategies and priorities

Theme	Adaptation strategy	Priority
Municipal	Provide training for staff on emergency management	High
	Conduct water supply planning	High
	Define drought triggers for different levels of response	High
	Take a watershed approach to municipal emergency response planning	High
	Identify high-risk areas for landowners and city	High
	Develop framework for implementing water use restrictions	Medium
	Promote coordination between municipalities	Medium
	Develop action plans for different types of drought (hydrological, meteorological, mechanical)	Medium
	Promote water conservation programs (e.g., low-flush toilets)	Medium
	Stockpile resources, such as water pipelines	Medium
	Develop agreements for sharing equipment and expertise across municipalities during emergencies	Medium
	Build redundancy into municipal water supply systems	Low
	Match water quality to water use requirements	Low
Agricultural	Improve access to and availability of climate/weather forecasting	High
	Expand producer crop and weather reporting network	High
	More hydrometric stations for real-time data	High
	Increase number of climate observation stations	High
	Develop effective monitoring and information systems	High
	Promote cross-organizational knowledge	High
	Improve integration of seasonal forecasts into crop planning	Medium
	Develop long-term preparedness and adaptation programs	Medium
	Define drought triggers for support from provincial and federal governments	Medium
	Base relief programs in part on reliable climate science	Medium
	Develop crisis line for drought management prior to drought	Medium

watershed. This coordination is exemplified in the ongoing collaboration between the SCCWS, the Saskatchewan Watershed Authority, and Agriculture and Agri-Food Canada on PARC's Vulnerability and Adaptation to Climate Extremes in the Americas (VACEA) project (2011–2016). VACEA is funded jointly by the International Development Research Centre and Canada's Tri-Council. On VACEA, key actors have been able to maintain their collaborative relationships to advance drought preparedness in the watershed, despite having to take advantage of a different funding source.

The drought preparedness initiatives also had many synergies with different projects already underway by the SCCWS. These projects include their watershed monitoring and invasive species programs, which track and report on watershed health issues and invasive species prevalence. More specifically, the drought preparedness work had synergies with the SCCWS's salt cedar monitoring and removal program, since salt cedar can have negative impacts (e.g., over-salinization) on existing water and soil resources. The negative impacts of salt cedar can amplify agricultural sensitivity to drought.

As noted earlier, several challenges are associated with implementation. For example, there is often a lack of clear responsibility for implementing different projects, which can paralyze the governance network. In some cases, local actors, such as the SCCWS, are left to implement projects on their own, even if they do not have a legislated mandate to do so. This problem is particularly apparent for addressing the salt cedar issue in the watershed, but it is also relevant for implementing many of the strategies in Table 5, such as promoting coordination between municipalities. Without formalized funding sources or programs, it is very difficult and often simply not possible to implement any course of action.

There are also several barriers to collaboration in the watershed. These include a pervasive rural-urban divide, which is relevant in many areas throughout the province (Partridge and Olfert 2009; Hoggart 1990), and also a fear in many municipalities that increased collaboration leads to forced amalgamation. Some of the participatory planning exercises and tools possibly helped address these barriers to some degree, since many of the strategies identified by participants in Table 5 relate to improved collaboration between municipalities, but the benefits of the activities are not necessarily long-lived and are at risk of easily being forgotten. Since the completion of this planning project in 2011, attempts to improve

municipal collaboration regarding drought and excessive moisture have had limited success, and stakeholders have not been able to make real progress in developing more specific action plans.

Conclusions

This case study provides several preliminary insights regarding collaborative drought preparedness in Saskatchewan.

First, it demonstrates the key role of local watershed stewardship organizations in preparing for drought. These organizations are able to provide multi-stakeholder, deliberative forums for bridging different perspectives and values regarding the direction of drought adaptation. In addition, watershed groups are able to nurture a forum for collaboration with a broad range of non-government and government actors across different levels (i.e., local, municipal, regional, provincial, and federal). Accordingly, watershed groups help the diversity of stakeholders take advantage of opportunities arising from different funding sources and program frames. However, watershed stewardship organizations only have an informal role in drought preparedness and are not empowered by any formal legislation in the Saskatchewan context, which enables their flexibility but can constrain their ability to act or influence water management decisions.

Second, this case study demonstrates the value of different boundary objects, such as participatory mapping, timelines, and scenario assessments, for engaging with different knowledge systems in deliberative processes. The general utility of these tools has been demonstrated elsewhere (e.g., Ravera et al. 2011; Kok et al. 2007), but this case confirms that they can be useful and practical when working on drought preparedness in Saskatchewan's watersheds. These boundary objects facilitated the development of an innovative drought preparedness plan, which, although preliminary, provided some guidance toward drought preparedness for key actors in the watershed.

Finally, this case reiterates that knowledge-bridging activities during planning are only the first piece of the puzzle in building drought preparedness. The role of the SCCWS has been crucial as a bridging organization to bring stakeholders together to begin preparedness planning. The research work of the case study, and related funding, were catalysts that

helped begin participatory planning by diverse stakeholders to consider developing preparedness plans. But plans can only be effective if they are implemented, monitored, and adjusted to ensure the desired results are achieved. Without clearly defined roles for the diverse stakeholders, or sustained commitment by all actors (including all levels of government), preparedness plans will suffer from an implementation gap and fail to realize their potential. Also, changing policy priorities, programs, and funding sources will limit actors' ability to implement plans. The lack of long-term, secure funding means even the sustainability of the watershed groups themselves is not assured. This case study suggests that continued collaboration between a core group of actors with varying interests and expertise can help improve capacity to adjust to changing priorities while maintaining general goals toward drought preparedness and sustainability. It must be emphasized that there is great value in participatory planning with a diversity of stakeholders. Once this planning process is initiated, a real challenge occurs when stakeholders need to move beyond planning into adaptive action.

Acknowledgments

Funding for the preparedness project was received from Natural Resources Canada as part of its Prairie Regional Adaptation Collaborative program (PRAC). As such, many of the ongoing PRAC research projects were used to inform the planning process. The Prairie Adaptation Research Collaboration (PARC) at the University of Regina led the PRAC, with the Saskatchewan Watershed Authority as the PRAC lead on the Drought and Excessive Moisture Preparedness theme for Saskatchewan. PARC contributed significant research expertise on climate change to the project, including on hydro-climate variability assessment and paleoclimate reconstruction. The community-based vulnerability assessment was completed by the University of Regina in collaboration with the Saskatchewan Watershed Authority, as part of both PRAC and a complementary Social Sciences Humanities and Research Council of Canada-funded project (the Rural Community Adaptation to Drought project). The Saskatchewan Research Council completed a characterization of extreme events in the watershed, and Dr. Steven Quiring from Texas A&M University completed an evaluation of climate extremes monitoring. The planning process was

also aligned with Agriculture and Agri-Food Canada's Drought Preparedness Partnership, which, although not officially part of PRAC, provided a provincial-level assessment of drought preparedness in Saskatchewan.

References

- Barrow, E. 2011. *Preliminary Probabilistic Analyses of Drought Indices in the Prairies*. Regina: Prairie Adaptation Research Collaborative. http://www.parc.ca/rac/fileManagement/upload/Preliminary%20Probabilistic%20Analysis%20of%20Drought%20Indices%20in%20the%20Prairies_June%202011.doc.pdf. Accessed October 2013.
- Berkes, F. 2009. "Evolution of Co-management: Role of Knowledge Generation, Bridging Organizations and Social Learning." *Journal of Environmental Management* 90: 1692–1702.
- Berkes, F., and C. Folke. 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge: Cambridge University Press.
- Bohensky, E.L., and Y. Maru. 2011. "Indigenous Knowledge, Science, and Resilience: What Have We Learned from a Decade of International Literature on 'Integration?'" *Ecology and Society* 16, no. 4. doi: 10.5751/ES-04342-160406. <http://www.ecologyandsociety.org/vol16/iss4/art6/>.
- Brand, F.S., and K. Jax. 2007. "Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object." *Ecology and Society* 12, no. 1.
- Cargo, M., and S.L. Mercer. 2008. "The Value and Challenges of Participatory Research: Strengthening Its Practice." *Annual Review of Public Health* 29, no. 1 (April): 325–50. doi: 10.1146/annurev.publhealth.29.091307.083824.
- Cash, D.W., W.C. Clark, F. Alcock, N.M. Dickson, N. Eckley, D.H. Guston, J. Jäger, and R.B. Mitchell. 2003. "Knowledge Systems for Sustainable Development." *Proceedings of the National Academy of Sciences* 100, no. 14: 8086–91.
- IPCC (Intergovernmental Panel on Climate Change). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- Hoggart, K. 1990. "Let's Do Away with Rural." *Journal of Rural Studies* 6, no. 3: 245–57.
- Kemmis, S., and R. McTaggart. 2000. "Participatory Action Research: Communicative Action in the Public Sphere." Pp. 559–603 in N. Denzin and Y. Lincoln (eds.), *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications.
- Kok, K., R. Biggs, and M. Zurek. 2007. "Methods for Developing Multiscale Participatory Scenarios: Insights from Southern Africa and Europe." *Ecology and Society* 13, no. 1.
- MREM (Ministers Responsible for Emergency Management). 2011. *An Emergency Management Framework for Canada*. 2nd edition. Ottawa, ON: Public Safety Canada.

- PARC (Prairie Adaptation Research Collaborative). 2010. *Hydroclimatic Variability: South Saskatchewan River Basin*. Regina: PARC. http://www.parc.ca/rac/fileManagement/upload/Hydroclimatic%20Variability_South%20Saskatchewan_River_Basin_%20March10.pdf. Accessed October 2013.
- Partridge, M.D., and M.R. Olfert. 2009. "Dissension in the Countryside: Bridging the Rural-urban Divide with a New Rural Policy." Pp. 169–210 in M. Gopinath and H. Kim, *Globalization and the Rural-Urban Divide*. Seoul: Seoul National University Press.
- Ravera, F., K. Hubacek, M. Reed, and D. Tarrasón. 2011. "Learning from Experiences in Adaptive Action Research: A Critical Comparison of Two Case Studies Applying Participatory Scenario Development and Modelling Approaches." *Environmental Policy and Governance* 21, no. 6 (November): 433–53. doi: 10.1002/eet.585.
- Reid, W., F. Berkes, T. Wilbanks, and D. Capistrano. 2006. *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington, DC: Island Press.
- SCCWS (Swift Current Creek Watershed Stewards). 2009. *Swift Current Creek Watershed Protection Plan*. Swift Current, SK: SCCWS. <https://www.wsask.ca/Global/Water%20Info/Watershed%20Planning/SwiftCurrentCreekWatershedProtectionPlanFinal.pdf>. Accessed October 2013.
- Smit, B., I. Burton, R. Klein, and J. Wandel. 2000. "An Anatomy of Adaptation to Climate Change." *Climatic Change* 45: 223–51.
- SRC (Saskatchewan Research Council). 2011. "Drought and Excessive Moisture—Saskatchewan's Nemesis: Characterizations for the Swift Current Creek, North Saskatchewan River, Assiniboine River and Upper Souris River Watersheds." Saskatoon, SK: SRC. <http://www.parc.ca/rac/fileManagement/upload/2Tsk%20Nemesis11%20SWA%20DEM%20Report%20updated.pdf>. Accessed October 2013.
- St. Jacques, J., Y.A. Huang, Y. Zhao, S.L. Lapp, and D.J. Sauchyn. 2011. *The Effects of Atmosphere-Ocean Climate Oscillations on and Trends in Saskatchewan River Discharges*. Regina: PARC.. http://www.parc.ca/rac/fileManagement/upload/The_Effects%20of%20Atmosphere_Ocean_Climate_Oscillations_on_and_Trends_in_Saskatchewan_River_Discharges.pdf. Accessed October 2013.
- Star, S.L., and J.R. Griesemer. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies of Science* 19, no. 3 (August 1): 387–420. doi: 10.1177/030631289019003001.
- Sundberg, M. 2007. "Parameterizations as Boundary Objects on the Climate Arena." *Social Studies of Science* 37, no. 3 (June 1): 473–88. doi: 10.1177/0306312706075330.
- Whitfield, S., and M.S. Reed. 2012. "Participatory Environmental Assessment in Drylands: Introducing a New Approach." *Journal of Arid Environments* 77 (February): 1–10. doi: 10.1016/j.jaridenv.2011.09.015.

- Wilhite, D.A. 1996. "A Methodology for Drought Preparedness." *Natural Hazards* 13, no. 3: 229–52.
- (ed.). 2005. *Drought and Water Crisis: Science, Technology, and Management Issues*. Boca Raton, FL: CRC Press.

