

# Recent Developments in Canadian Water Policy: An Emerging Water Security Paradigm

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**Abstract:** Based on a large-scale survey, in-depth interviews, and a facilitated workshop, the authors document the concerns held by water policy makers, managers, and practitioners regarding the limitations of water security assessment capacity in Canada. A primary objective of the research presented in this paper was to refine and test a definition of water security relevant to the Canadian context. The second objective of the research was to determine whether, how, and why Canadian water managers use water monitoring and assessment tools that could support improved water security. In closing, the analysis suggests that a broad definition of water security may, under certain conditions, be helpful in framing water-related concerns in Canada.

**Résumé:** À partir des résultats d'une enquête de grande envergure, des entrevues en profondeur et d'un atelier dirigé, nous dressons un portrait des préoccupations soulevées par des responsables politiques, des gestionnaires et des praticiens œuvrant dans le domaine de l'eau qui se sont exprimés au sujet des limites auxquelles se heurtent les capacités d'évaluation de la sécurité hydrique au Canada. Le présent article s'inscrit dans la lignée des travaux de recherche visant à peaufiner et à vérifier la pertinence de la définition de la sécurité hydrique dans le contexte canadien. L'autre objectif de cette recherche est de mettre en évidence les raisons qui motivent les gestionnaires de l'eau au Canada à mettre en place des outils de surveillance et d'évaluation des ressources en eau pouvant favoriser l'amélioration de la sécurité hydrique, ainsi que le degré et les modalités d'utilisation de ces outils. Il se dégage de cette étude qu'une définition globale de la sécurité hydrique peut, dans certaines circonstances, servir à mieux cerner les préoccupations qui se manifestent au Canada dans le domaine de l'eau.

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## Introduction

As documented in this paper, water policy makers, managers, and practitioners have significant concerns about the limitations of water security assessment capacity in Canada. A recent survey indicates that more than 360 fresh water-related tools have been developed over the past two decades to assess and monitor water quality and quantity in Canada (Dunn and Bakker, in press). These tools have been developed in response to growing concerns about fresh water in Canada (Bakker, 2007; Brooks, 2005; de Loë *et al.*, 2007; Plummer *et al.*, 2005; Sproule-Jones, 2002).

The analysis also suggests that water policy-makers, managers, and practitioners are in search of a more comprehensive and holistic approach to address mounting concerns about fresh water-related issues. The authors suggest that this approach is helpfully characterized by the concept of “water security”. In this paper, the relevance of this term is explored in the context of Canadian water management. This finding builds on scholarship documenting the need for greater integrated water governance in Canada (Mitchell, 2005, 2007; Mitchell and Shrubsole, 1997). The authors support our argument through data drawn from a large-scale survey, interviews, and a facilitated water security workshop with water managers and practitioners across Canada.

To develop these claims, context on the concept of water security is provided. The authors present and analyze survey and interview data and explore governance-related issues identified by respondents as contributing factors in the limited uptake of fresh water-related monitoring and assessment tools: lack of integration, fragmentation, and limited attention to good governance process. It is concluded with the suggestion that water security, broadly defined, is a likely model to help communities address increasing water stresses.

A primary objective of the research presented in this paper was to refine and test a definition of water security relevant to the Canadian context. The second objective of the research was to determine whether, how, and why Canadian water managers use water monitoring and assessment tools that could support improved water security.

The past 20 years have witnessed a rapid increase in environmental assessment tools. Fresh water is no exception: recent research documents the existence of

over 360 fresh water-related monitoring and assessment tools in Canada (Dunn and Bakker, in press). At the same time, concerns over water security have grown. In Canada, concerns have grown over drinking water quality, water availability, and environmental water quality (Commissioner for the Environment and Sustainable Development [CESD], 2001, 2005; The Standing Senate Committee on Energy, the Environment and Natural Resources [Senate], 2005; Kelly *et al.*, 2010). Ongoing boil water advisories throughout Canada – particularly in small and First Nations communities – are another focus of concern (Phare, 2009; Senate, 2005). Recently, the term “water security” has been used to express the inter-related nature of these concerns (de Loë *et al.*, 2007).

Internationally, the term “water security” has also garnered increased attention (de Loë *et al.*, 2007; Falkenmark, 2007; Grey and Sadoff, 2007; Savenije and Van der Zaag, 2008; Swaminathan, 2001; Ferreyra *et al.*, 2008), playing central roles in international meetings such as the World Water Forum (Global Water Partnership, 2000) and the World Economic Forum (2009). The World Economic Forum recently described water security as “the gossamer that links together the web of food, energy, climate, economic growth and human security challenges that the world economy faces over the next two decades” (World Economic Forum, 2009).

The concept of water security remains without a generally agreed-upon definition. Definitions are often narrow, discipline-specific and, in some cases, contradictory (Cook and Bakker, submitted). Examples of different interpretations of water security appear in Table 1.

A primary objective of the research presented in this paper was to refine and test a definition of water security relevant to the Canadian context. Below, the authors suggest – and the analysis supports – that an integrated definition of water security provides a useful way to frame the increasingly complex and inter-connected water issues of the 21<sup>st</sup> century. As such, we define water security as: “sustainable access, on a watershed basis, to adequate quantities of water, of acceptable quality, to ensure human and ecosystem health.” This definition was developed and tested through consultation with Canadian water managers and policy makers. It has, as the authors argue, a number of advantages: it is consistent with the principles of Integrated Resources Management

**Table 1: Emerging definitions of “water security”: Comparing criteria Canadian and international approaches to water security**

	<b>Global Water Partnership</b>	<b>Changing the Flow</b>	<b>Canadian Water Sustainability Index</b>	<b>Water Allocation &amp; Water Security</b>
<b>Water Resources</b>	Water Resources – sharing	Enhancing Capacity for Freshwater Protection & Responding to Climate Change	Availability, Supply, Demand	Economic Production Climate Variability and Change
<b>Ecosystem Health</b>	Ecosystem Protection	Protecting Aquatic Ecosystems	Stress, Quality, Fish	Ecosystem Protection
<b>Human Health</b>	Meeting Basic Needs Securing Food Supply	Securing Safe Drinking Water	Access, Reliability, Impact	
<b>Infra-structure</b>	Managing Risk Valuing Water	Water Conservation	Demand, Condition, Treatment	Water Conservation
<b>Governance</b>	Governing Water Wisely	Protecting Aboriginal Rights Preventing Interjurisdictional Conflicts and Bulk Water Exports Quality Science Program Design	Capacity: Financial, Education, Training	Equity & Participation Transboundary Sensitivity

Dimensions of Water Security

(for example, implying the need to integrate land and water use planning); it explicitly identifies the need for baseline requirements; and it suggests that attempts to attain water security require monitoring, assessment and prediction over scales (both temporal and spatial) (Dubé, 2003; Dubé *et al.*, 2009).

This emphasis on monitoring and assessment constitutes the second objective of our survey: to determine whether, how, and why Canadian water managers use water security assessment tools. Recent research indicates that fresh water-related monitoring and assessment tools have proliferated in Canada over the past decade; over 360 tools have been developed by governments and non-governmental organizations (Dunn and Bakker, in press). This paper presents research results on the uptake and implementation of these monitoring and assessment tools, as a means of evaluating the effectiveness of water security assessment in Canada.

## Methods

The findings are based on results from a large-scale web-based survey, interviews, and a facilitated expert workshop conducted between November 2008 and September 2009. This research is part of a four-year research project on water security, funded by the Canadian Water Network (see Program on Water Governance website at [www.watergovernance.ca](http://www.watergovernance.ca) for more details on the project).

In November and December 2008, a large-scale web-based survey of Canadian water practitioners was conducted to assess water security across Canada (referred to in this paper as the 2008 Water Security Survey). The primary target audience of the survey was water managers (including utility managers), water regulators, and community watershed groups, in addition to federal and provincial policy makers. The survey respondents represented every province and territory in Canada. The majority of the survey respondents (64 percent) work in integrated (surface and ground) water management; 14 percent reported working with groundwater; and 22 percent with surface water. The survey was administered to 512 individuals with a response rate of 20 percent.

Follow-up survey interviews were conducted between May and July 2009. These hour-long interviews with water managers and policy makers

from across Canada were conducted by phone (referred to in this paper as the 2009 Water Security Interviews). In September 2009, a one-day workshop with sixty practitioners from across Canada was held in Vancouver, British Columbia. During this workshop, experts from across the country discussed and debated the concept of water security (referred to in this paper as the 2009 Water Security Workshop).

Participants in the web-based survey, follow-up interviews, and workshop came from diverse political and jurisdictional backgrounds, and included senior-level civil servants, municipal engineers and grassroots organizers. The Behavioural Research Ethics Board at the University of British Columbia approved the research methods and the certificate remained current throughout the study project. In keeping with ethics review process, all names of the respondents are withheld.

The authors recognize the potential for a bias with this methodological approach, as participants self-select to participate in the research project. However, an attempt to mediate the impacts of self-selection was made by ensuring the representation of a diverse range of actors (both geographically and in terms of professional representation). A large number of respondents were from British Columbia (due to the location of our program of study), which may also have influenced results. However, triangulating the methods – through a survey, interviews, and focus group – aimed to reduce the potential bias.

## Results

### **Water security: Baseline understanding and key issues**

How do Canadian water managers and policy makers currently perceive “water security?” The term “water security” continues to make its way into the discourse of water practitioners in Canada. The majority of the water managers and end users interviewed (67 percent) reported hearing the term “water security” between two and five years ago; 22 percent reported that they had never heard the term before this research project; while another 22 percent reported that they have known and / or used the term for ten or more years. Most respondents noted a dramatic increase in the use of the term over the past two years.

Despite the increased use of the term, the interviewees confirmed that, to date, little agreement exists over the definition. Although common components within the definition of water security exist, few are holistic. For example, one interviewee who is involved in water governance on a national scale articulated the disparate views of water security. The respondent discussed how at a national roundtable meeting, half of the people discussed water security in a military context, while the other half contextualized it in terms of human security (water quality and quantity). The respondent felt that the employment of the term occurred without a nuanced and critical discussion of the definition.

In general, the water managers and end users involved in the research commonly reported that although the term has a growing amount of support in the water management world, the wide array of interpretations limits its uptake. In response to this issue, the interview respondents generally concurred that the development of a common, more unified, definition holds considerable promise, the adoption of which would likely lead to better water governance practices—particularly if the development process is collaborative in nature.

The respondents reported a wide range of interpretations of water security, as identified in Figure

1. The most commonly reported themes included “sustainability,” “access,” and “safety/human health.” The prevalence of “sustainability” was noteworthy considering the interview results largely highlighted the weaknesses associated with the term—noting that the term had become “diluted” and “amorphous” over the years. This sentiment was articulated by a federal employee from eastern Canada, who suggested that the term water security “works better” than sustainability because “it is more naturally in our discourse.” Similarly, a federal-level water scientist reflected that the phrase solicits proactive behaviour and connotes long-term planning to “stay secure and protect our families and grandchildren.”

Strengths in the adaptation of “water security” as a governing framework included the fact that it was “action-oriented.” Interviewees and attendees of the 2009 Water Security Workshop commonly reported this “action-oriented” quality of the term. The benefits of this framing included that it allowed individuals and communities to work towards a common goal and that it tended to capture peoples’ imagination and incite action. That is, if a community experienced water *insecurity*, the development of action plans could address the specific sources of water security.

Our analysis identified the main sources of water insecurity for the responding water managers and policy

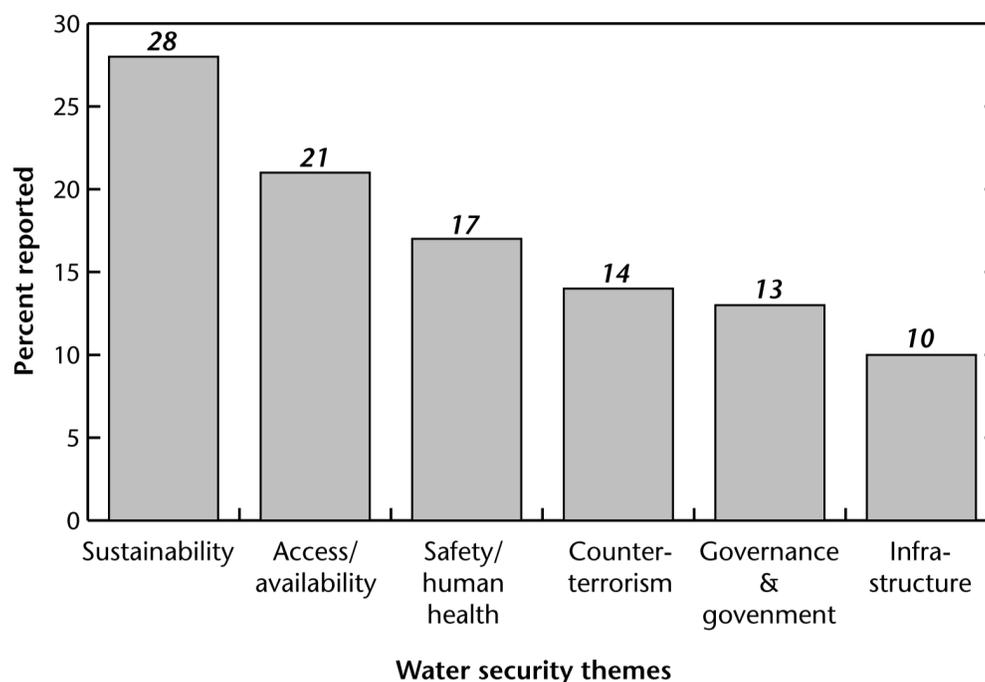


Figure 1: Key themes survey respondents identified as part of water security

makers. The most commonly occurring responses of sources of water insecurity in the 2008 Water Security Survey included: water-quality related issues, lack of connection between governance practices, water systems planning and actual problems, as well as water quantity issues, as reported in Table 2. In addition, the lack of coordinated water-related datasets throughout Canada and the lack of federal leadership in defining a water strategy were key concerns voiced in the 2008 Water Security Survey, the 2009 Water Security

Interviews, and the 2009 Water Security Workshop, as discussed below.

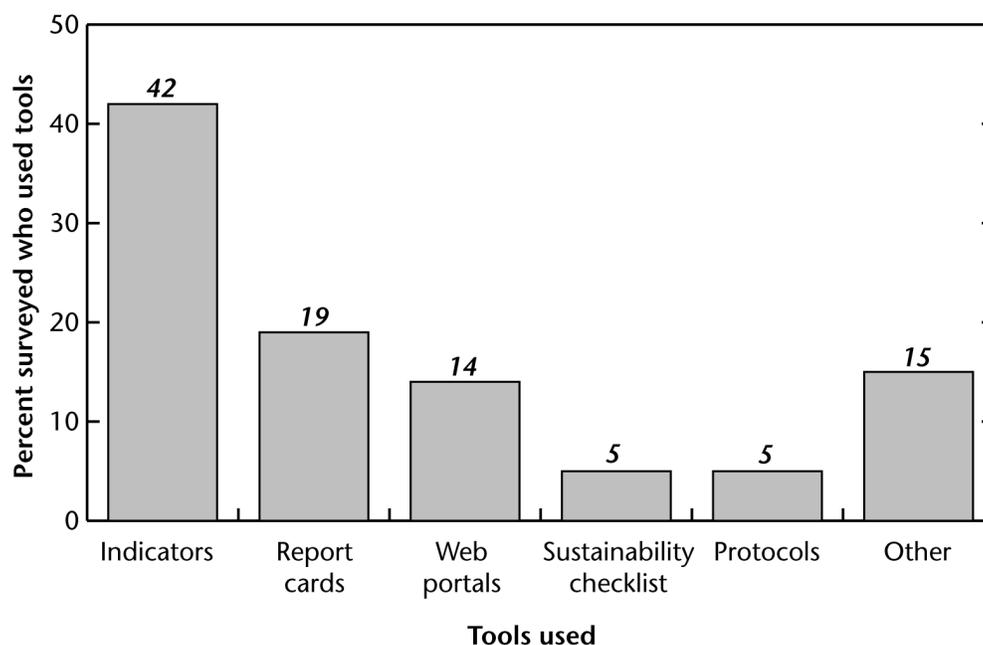
### **Monitoring and assessment: Lack of integration**

Although sixty percent of the practitioners surveyed noted that they use water monitoring and assessment tools in some capacity, only a limited number of the 365 available water indicators were employed. (The authors use the word “tool” as an umbrella term that encompasses indicators, indices, performance measures, report cards, and sustainability checks.) The reported use of monitoring and assessment tools range in type (Figure 2) and in frequency. The survey respondents mainly use water assessment and monitoring tools to:

- identify priorities and budgets (planning);
- raise and improve awareness (particularly in communicating with the public);
- translate knowledge; enable informed decision making;
- aid in the evaluation and approval (through decision making) processes; monitor and measure progress; and
- compare outcomes (either with other areas, or “past versus current” trends and future scenarios).

**Table 2. Reported drivers of water insecurity**

Drivers of Water Insecurity	Percent Reported
Water quality issues	43
Governance (government/planning and regulatory issues)	36
Quantity/supply issues (availability)	38
Infrastructure	23
Groundwater	17
Access/source protection “security”	17
Insufficient data/lack of knowledge	14
Climate Change	13
Funding	10
Industry	6



**Figure 2: Types of water assessment tools used by water managers and policy makers in Canada**

The frequency of use ranged from annually (26 percent); daily (22 percent); weekly (17 percent); monthly (15 percent); semi-monthly (3 percent) and occasionally (17 percent).

Both survey and interview results indicate a lack of integration for assessment and monitoring. In particular, the lack of standardization between the monitoring and assessment tools was reported to impede the assessment of wider trends and transferability of information between regions (and jurisdictional scales). Specifically, the main gaps with water-related monitoring and assessment tools included: data and knowledge related issues (52 percent); governance related issues (including decision making and transparency) (26 percent); institutional capacity (such as lack of human resources, lack of time, training issues, and lack of institutions) (14 percent); and lack of funding (8 percent).

A significant finding of this study is that thirty-eight percent of the people surveyed reported that they have tools available to them, yet chose not to use them. Despite the number of tools available to them, the respondents generally found the existing monitoring and assessment tools fragmented and difficult to use. The fragmentation often resulted from the project-specific nature of the tools that did not translate spatially (between jurisdictions) or temporally (beyond the scope of projects). In addition, lack of available data to run the calculations impeded the usefulness of many of the tools, as discussed below. A central criticism of current monitoring and assessment tools is that they require staff time and training that exceeds the capacity of most institutions. As such, more than half of those surveyed indicated dissatisfaction with the tools currently available to them.

This finding highlights the current disconnection between availability and capacity of water governance tools. It also underscores the importance of including “on the ground” water practitioners, policy makers, and community members in the development and testing of tools; something that is not always done at the design stage. This was identified as a key area in need of development in the 2009 Water Security Workshop participants.

Data-related issues also emerged as a central barrier for achieving water security. The water practitioners and policy makers voiced strong concern for the lack of centralized, coordinated, and consistent water-related data. These concerns were voiced both

vertically and horizontally—across jurisdictions and between different user groups and water managing organizations. Data “gaps” were also identified as a key concern for many of the practitioners. This lack of data availability is particularly pronounced in rural, remote, and First Nations communities. In addition, the respondents advocated for integration of information (both jurisdictionally and between academic models and the needs of end users).

Overall, the main data-related issues that emerged from the 2008 Water Security Survey, 2009 Water Security Interviews and 2009 Water Security Workshop include: lack of knowledge and manpower, limited or no (and inaccessible) First Nation reserve-based data, absence of a central repository, inconsistent monitoring networks, no legal requirements to track information, lack of data on emerging contaminants, and a need for more comprehensive water security assessments in less “technical” language. Time restraints for implementing the information gathered was another major concern voiced by the water managers and policy makers.

The difficulty in identifying fresh water-related data sources is consistent with previous research (Centre for Indigenous Environmental Resources [CIER] and Morin, 2006; Policy Research Initiative [PRI], 2007). The PRI, for example, reports that of the approximate 60 data sources that community members need to calculate the recently developed Canadian Water Sustainability Index (CWSI), less than half of the information (46 percent) was available to the six test communities. The test communities reported that data acquisition was a central barrier to implementing the index.

This issue has emerged with the general lack of implementation of the Water Quality Index (WQI) developed by the Canadian Council of the Ministers of the Environment (CCME). The CCME is the only index to be adopted nationally. Although the WQI is largely considered a sophisticated and robust index, the ability to calculate the index is largely inhibited by the lack of data available at the community level (PRI, 2007).

Concomitant with the lack of data was a “lack of national framework” for water policy issues in Canada and a concrete need for an active federal involvement in water-related issues. The respondents noted that the asymmetrical distribution of power between provincial and federal governments further impedes a comprehensive governance approach. The

fragmentation perpetuates idiosyncratic governance. Accordingly, each jurisdiction tends to develop tools within their specific boundaries with very little sharing (as we discuss below). This finding coincides with an earlier analysis conducted, which documented the highly diverse and fragmented water legislation and policy in Canada—particularly in regards to drinking water protection, watershed governance, water rights, water exports, and transfers (Hill *et al.*, 2008). The observation that Canada is one of the most decentralized countries in the world in terms of water governance (Hill *et al.*, 2008; Paehlke, 2001; Fitzgibbon *et al.*, 2006; Veale, 2007) proves to be a point of concern for many of the water managers and policy makers interviewed.

Inconsistencies within provincial governance systems exacerbate the issue. For example, when collecting information regarding water permits, the Government of Ontario has one department assigned to manage water permits, whereas Alberta and Saskatchewan have two divisions within a single department that deal with water licenses of groundwater and surface water separately (CIER and Morin, 2006; PRI, 2007). When water systems transcend jurisdictional scales (provincial, territorial, and national), the issues involving the coordination of data are exacerbated (Norman and Bakker, 2009). Overall, our analysis suggests that little transparent coordination between water managing organizations exists in Canada, yet there is a strong desire for this to occur.

### **Limited attention to governance issues**

Governance is an often underemphasized element in achieving water security. Water governance, simply defined, is the decision-making process by which water is managed. This includes the range of political, organizational and administrative processes through which communities articulate their interests, their input is absorbed, decisions are made and implemented, and decision makers are held accountable for the development and governance of water resources and delivery of water services (Bakker, 2002). Effective water governance also involves the widening of participation in the decision-making process beyond governmental actors. As Brandes and Curran (2009: 2) suggest,

[T]he goal of improving governance is to build flexibility and resilience into the governance structure, thus enhancing the ability to adapt and effectively address current and future challenges. This contrasts with traditional centralized approaches to decision making and management; yet it is increasingly recognized both globally and nationally as the critical priority.

Responses from the 2008 Water Security Survey, follow-up interviews, and workshop underscored the need to prioritize governance in water-related frameworks. The respondents articulated the importance of stakeholder participation, both in terms of buy-in from community members and accountability for policy makers. In addition, respondents articulated the

**Table 3: Key themes identified by interviewees and workshop participants as needs to achieve water security (listed in order of frequency reported)**

Coordination of datasets
Increased funding for local and regional level stewardship projects
Better coordination of water management between political jurisdictions
A more holistic approach to water governance (including ecological, health, economic and cultural aspects)
Wider adoption of a watershed approach
Better coordination of groundwater and surface water systems
Ongoing monitoring of ecological systems (both spatially and temporally)
Better communication between academic research, policy decisions, and community (in particular between rural and First Nations communities)
Increased involvement/re-engagement of federal level governmental officials.

need for greater transparency in the governance process and capacity building for stakeholder participation to stave off issues before they arise (or escalate). For example, 38 percent of the survey respondents identified governance or government as a source of “insecurity” in their organization (see Table 2).

However, in an inventory of fresh water-related assessment and monitoring tools in Canada, only two out of 365 tools were found to include governance (Dunn and Bakker, 2009). At the provincial scale, Alberta tracks the number of watershed stewardship organizations and Saskatchewan tracks whether citizens have meaningful access to information about the quality of water. These tools measure governance outcomes, the most common type of governance assessment and monitoring tools, but do not offer a holistic view of governance practices (Kaufmann and Kraay, 2008). At the national level, the Canadian Water Sustainability Index includes a governance component—described as “capacity.” The tools for measuring capacity include training for water managers, financial capacity (per capita surplus or deficit), and community education level. However, the PRI self report—and case studies confirm—that this component, in its current form, falls short in capturing the nuances of governance (CIER and Morin, 2006; PRI, 2007).

Approximately 80 percent of the interviewees concurred that the watershed was the most appropriate scale to govern water resources. This response supports the body of literature recognizing the values of watershed-scale governance (McGinnis, 2001; Mitchell, 2005, 2007; O’Conner, 2002). The watershed scale is by no means a problematic (see Ferreyra *et al.*, 2008, for critical discussion of watershed-scale governance). In particular, the difficulty of applying data (which is often captured at a municipal, provincial or national scale) to a watershed scale is an ongoing challenge. Additionally, the exclusion of groundwater in a watershed approach was also a noted concern. Despite these very real issues, respondents suggest that the watershed scale is still one of the best approaches and with commitment to better data exchange, a watershed approach would be a more feasible approach.

In addition, the respondents stressed that all levels of government need to be invested in this process; particularly to align data that represent multiple geographical scales (i.e., municipal versus provincial). For example, the WQI is used as an indicator of

ecological health in the CWSI; however, during the field testing of the index, none of the communities were able to obtain enough information to include it in the calculation (PRI, 2007). To help remedy this shortcoming, respondents articulated the need for both vertical and horizontal integration of information and inter-jurisdictional cooperation.

### **Fragmentation**

The diverse range of water-related legislation within territories and provinces was reported to hinder efforts to address water-related issues in a comprehensive and streamlined manner. This fragmentation occurred both in management and governance activities. The reported fragmentation is not a surprise given the historic roles of government agencies in Canada—and the subsequent organization of governance systems. As in many federal states, the responsibility for governing Canadian water resources is distributed between different orders of government. The constitutionally defined distribution of powers allocates responsibility for international waters, fisheries, and navigation to the federal government, whereas water supply and resources are provincial responsibilities (who conventionally delegate water supply to regional or municipal governments). At its roots, the provincial responsibility over fresh water resources is part of the general policy of provincial ownership over natural resources, which the legislative rights in the *Constitution Act* of 1867 reinforce. The federal jurisdiction over water extends into treaty-making powers, international trade agriculture, taxation, trade and commerce, treaty-making powers and international trade as well as the general doctrine of “peace, order, and good government” (POGG)—however, the general trend has been for the federal government to interpret this role narrowly (Norman and Bakker, 2010).

Moreover, at both provincial and federal levels, a range of governmental departments and agencies share responsibility for different aspects of the water cycle. This is not unusual given that water is a flow resource which transcends fixed borders (and hence is inescapably multi-jurisdictional), and given the multiple uses of water, which is essential for industry, fisheries, agriculture, tourism and human water supply. However, many experts suggest that jurisdictional fragmentation and patchwork of federal and provincial

laws in Canada have led to confusion over appropriate roles and scales of responsibility (Bakker, 2002; Biswas, 2008; Hill *et al.*, 2008; Norman and Bakker, 2009, 2010).

Efforts to clarify the role of federal and provincial actors (through the 1928 Powers Reference and the 1945 Dominion-Provincial Conference on Reconstruction) have been met with limited success. In addition, efforts to strengthen the federal role (through the passage of the 1970 Water Act and the 1987 Federal Water Policy) remain unimplemented (Norman and Bakker, 2010; Saunders and Wenig, 2007). In the August 2009 Council of Premiers' meetings in Regina, which focused on innovations to "green the economy," the Premiers called upon the federal government to modernize the *Canadian Environmental Assessment Act* (The Council of the Federation [Council], 2009). While not directly related to water governance, the end-goal of efficiency, reduction of overlap, and elimination of preventable delays in decision making, while ensuring the highest environmental standards, echoes the calls made by water managers and policy makers for more coordinated water legislation.

An important issue with respect to fragmentation is the participation of non-governmental actors in the governance of resources such as water (Allee, 1993; Alper, 1997; Day, 2004; de Loë *et al.*, 2002; Feitelson and Haddad, 1998; Gibbins, 2001; Konrad and Nicol, 2008). This widening of responsibility to include non-state actors in the governance of natural resources has many potential benefits, including increased vertical and horizontal information exchange and increased transparency—areas that were listed as priorities for the respondents of the 2009 Water Security Interviews, and the Water Security Workshop participants.

However, the increased involvement of actors is far from straightforward. Previous research found that the increased involvement of local actors in water governance systems does not necessarily translate to increased capacity for users of this system (Norman and Bakker, 2009, 2010). Rather, significant barriers exist that may limit the ability of water managers and end user groups at a local scale to effectively participate in water governance. In short, although water governance systems increasingly involve local actors, their ability to influence policy decisions remains limited.

## Conclusions: Looking forward—The potential and limits of water security

The main contribution of this paper is the documentation of limitations on water security assessment capacity in Canada, in the opinions of water policy makers, managers, and practitioners. The results from the research underscore two main points: a disjuncture between available tools to assess and monitor water security and the governance processes necessary for their implementation; and, consequently, a desire for a more holistic and integrative approach to water governance in Canada.

A key finding was the lack of integration for assessment and monitoring. In particular, a lack of standardization between assessment and monitoring tools was reported to impede the evaluation of wider trends and transferability of information between regions (and jurisdictional scales). In addition, lack of coordination (both in terms of data sharing) and long-term planning was identified in the survey, interviews, and workshop as key sources of water insecurity. This research indicates that water managers and end users in Canada are largely dissatisfied with current water governance models and are looking for a more holistic approach to water governance that is comprehensive, action-oriented and user-friendly. This finding builds on previous research findings (Mitchell, 2005, 2007) relating to the need for greater integration of water governance in Canada (de Loë *et al.*, 2007).

The analysis found that a wealth of excellent assessment and monitoring tools exist in Canada, however, because they are often limited in time and scope (often linked to specific projects and are not connected to baseline information) and often not coordinated at meaningful scales, their utility is limited. Adapting this concept as an end goal may assuage many of the dissatisfactions with current models as well as complement existing models. As such, a key contribution of our research documented the general receptiveness to the concept of water security as a potential governance framework.

In addition, the analysis has suggested that the working definition of water security proposed by the authors may be useful to water managers and policy makers, for several reasons: the definition is holistic and integrative in scope, addressing both water quality and water quantity issues; it explicitly includes ecological and human health; it is conceived at a watershed scale;

and the term is action oriented. This approach is in line with approaches developed under the framework of Integrated Water Resources Management (Biswas, 2004, 2008; Gleick, 2000). However, there are some constraints on the potential utility of the concept of water security. For the concept of water security to reach its potential, we argue that water security must be broadly defined and versatile—fitting the needs of a changing environment and society. This requires an integrative, holistic, and comprehensive approach to water governance. It also requires the participation of, and buy-in from, policy makers, water managers, and community members.

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