Water Security: Emerging debates in policy and academia

Abstract

This paper critically analyzes emerging definitions of water security. The analysis consists of a comprehensive meta-analysis of distinct (and sometimes competing) definitions of water security in the academic literature, and comments on related developments in policy debates. We critique narrow definitions of water security, and argue instead in favour of a broad and holistic definition of water security that, we suggest, complements Integrated Water Resources Management paradigms. The paper then presents a case study of the emergence of a water security approach in Ontario, Canada. In conclusion, we reflect on broader questions of environmental governance as a means of situating the emergence and uptake of the water security paradigm.

Keywords

water security, environmental governance, market environmentalism, environmental security

INTRODUCTION

The concept of water security has received increased attention over the past decade in both policy and academic debates. Multiple definitions of this concept exist, promoted by a range of international organisations—notably the Global Water Partnership, UNESCO, and the World Economic Forum. Water security has also come to the fore of domestic water management agendas in the past decade, particularly where this is associated with (bio-)terrorism concerns. This paper evaluates the major reasons for the emergence of water security, discusses its various definitions, and explores the relationship of water security with Integrated Water Resources Management (IWRM). The analysis is necessarily exploratory, given that 'water security' is (at best) an emerging paradigm.

This analysis is merited, in part, because a growing number of organisations have identified water security as a concern. Foremost amongst these is the Global Water Partnership, which introduced a broad definition of water security at the Second World Water Forum in 2000 (discussed below). Other groups identifying the importance of water security include the European Water Partnership that, in 2007, organised a European Policy Summit on Water entitled *Water Security – does Europe have a Strategy?* (European Water Partnership, 2007); UNESCO's Institute for Water Education, which has made water security a research theme (Unesco-Ihe, 2009); and the Asia-Pacific Water Forum which, in 2007, held the first Asia-Pacific Water Summit entitled *Water Security: Leadership and Commitment* (Asia Pacific Water Forum, 2007). At its Summit on the Global Agenda in Dubai in November 2008 the Network of Global Agenda Councils of the World Economic Forum discussed water security extensively (World Economic Forum Network of Global Agenda Councils, 2008).

In summary, over the past decade the concept of water security has been increasingly taken up by water professionals, policy-makers (domestically and internationally), and (as explored below) in the academic literature (Spring and Brauch, 2009). This raises a number of questions: How is water security defined? Why has this concept emerged? And what is the relationship of water security to more long-standing approaches to water management, such as IWRM? This paper seeks to answer these questions. The second

section of the paper documents the emergence of the term 'water security' in policy and academic debates. It identifies distinct (and at times incompatible) definitions of water security currently being employed. Many of these definitions are constrained to issues of quantitative resource availability ('supply security'), or to issues of protection against terrorist threats (to both water quality and quantity). But other definitions emphasise the need to approach water security in a holistic and broad fashion. This paper takes the latter view while exploring water security's relationship with the paradigm of IWRM. Water security, we argue, may provide a useful mechanism through which to complement traditional approaches to IWRM. To explore this latter point, the third section of the paper presents a case study of the implementation of a water security approach in Ontario, Canada. In conclusion, we reflect on broader questions of environmental governance as a means of situating the emergence and uptake of the water security paradigm.

WATER SECURITY: AN EMERGING PARADIGM?

The first broad definition of water security emerged at the Second World Water Forum at The Hague in 2000. There, the Global Water Partnership (GWP) presented its report, *Towards Water Security: A Framework for Action*, to support implementation of the World Water Vision that was prepared by the World Water Commission. According to the GWP "[W]ater security at any level from the household to the global means that every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced" (Global Water Partnership, 2000).

This broad definition sets baseline requirements for water resources management in a watershed on a continuous basis – for "life" – and demands access to adequate quantities of acceptable quality of water for both humans and the environment. The GWP's choice of the term water security was a deliberate attempt "to capture the complex concept of holistic water management and the balance between resource protection and resource use" and to recognise the need for analysis at multiple scales (Global Water Partnership, 2000). At publication in March 2000, the GWP had great expectations for the role water security could play in attaining some of what would, later that year, become the Millennium Development Goals, "[T]ogether with improvements in health, education, energy and food security, increased water security can avoid threats from pollution and support the overall goal of poverty alleviation, improved human wellbeing, productivity and capacity alongside environmental sustainability" (Global Water Partnership, 2000):12.

At the conclusion of the Second World Water Forum, the *Ministerial Declaration of The Hague on Water Security in the 21st Century* approved and incorporated the concept of water security without defining it (Second World Water Forum, 2000). Instead, the Declaration parses out seven main themes of water security – meeting basic needs, securing the food supply, protecting ecosystems, sharing water resources, managing risks, valuing water, and governing water wisely. Today, many definitions of water security in the academic literature can be traced to either the GWP definition or the Ministerial Declaration's seven themes. After the Second World Water Forum the term water security appeared more frequently in the academic literature. Scholars from a variety of disciplines articulated their own definitions of water security, some broader than others. The broadest definitions of water security follow on the Second World Water Forum water security documents (the GWP report and the Ministerial Declaration). As explored below, narrow or univariate definitions are often specific to a disciplinary context and focus on a particular aspect of water security, such as security of water supply.

Moving Beyond the Hydraulic Mission: Narrow versus broad definitions of water security

Early definitions of water security were developed within a traditional paradigm of water management characterised by large-scale expansion of water resources infrastructure, and a concern with security of supply availability (Gleick, 2000). That paradigm, known as the 'hydraulic mission' (Brichieri-Colombi, 2009) was driven by three factors – population growth, changing standards of living and expansion of irrigated agriculture (Gleick, 2000). This traditional management approach "relied on projecting future populations, per capita water demand, agricultural production, and levels of economic productivity" (Gleick, 2000).

Reflecting that traditional paradigm, "early" definitions of water security (dating from the 1990s) were concerned mainly with quantity and availability of water to satisfy human needs. When linked to the concept of food security, water security was defined as the ability to "provide adequate, reliable water resources for populations living in the world's drier areas" (Clarke, 1993). Clarke acknowledged that the "parallel to food security" was imperfect: "water is not traded, as is food; there is not an international water market to stabilise; and that water cannot (yet) be shipped from one region to another as can food" (Clarke, 1993). Notably, today scholars of 'virtual' water argue that water is traded, not only literally in bottles, but also virtually in food (Allan, 2003).

In 1994, the United Nations Development Programme's 1994 *Human Development Report - New Dimensions of Human Security* (HDR 1994) introduced a revised concept of human security that "equated security with people rather than territories, with development rather than arms" (United Nations Development Programme, 1994). That report set out seven categories of threats to human security: economic security, food security, health security, environmental security, personal security, community security, and political security (United Nations Development Programme, 1994). Without a specific category of water security, policymakers and academics primarily addressed concerns of water (in)security as a component of food security. In two Food and Agricultural Organization (FAO) papers from 1997, water security is defined within a discussion of water scarcity. In one, water security is "a situation of reliable and secure access to water over time"(Appelgren, 1997). The other FAO paper insists that "[T]he essence of water security is that societies should have sufficient access to water, or that they should have the means to limit the damage caused by shortages" (Winpenny, 1997). Despite the emergence of "water security" at the Second World Water Forum, the trend to define water security as a component of food security has persisted (Biswas, M.R., 1999; White et al., 2007; Fao Land Division and Development, 2000). These FAO definitions of water security are narrow, concerned as they are with availability of water for humans.

An exemplar definition of water security from the 1990s highlights the broad focus on human needs of water, but fails to address ecosystem needs, positing that "[W]ater security is a condition where there is a sufficient quantity of water at a quality necessary, at an affordable price, to meet both the short-term and long-term needs to protect the health, safety, welfare and productive capacity of position (households, communities, neighborhoods, or nation)" (Witter and Whiteford, 1999).

More recent definitions may still focus on human needs, but often take an integrative approach to water security. For example, a discussion paper for the World Economic Forum 2009 meeting 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 Water Initiative, 2009).

We argue below that there is a need for a broad understanding of the concept of water security that is complementary to existing management practices, notably IWRM, in

which both human and ecosystem needs are accounted for. In the next section we review narrow definitions of water security. We then turn to review broad definitions of water security.

Narrow Definitions of Water Security

"Narrow" definitions of water security are found in the physical and social sciences as well as in the policy literature. For hydrologists the security of water supply is conceived of as security of the entire hydrological cycle (Tuinhof et al., 2005; Oki and Kanae, 2006; Johansson et al., 1999). Other literatures constrain the definition of water security depending on the use or geographic location of the water supply: developing world drinking water supply & sanitation (Biswas, Asit K. and Seetharam, 2008) (Lundqvist, Appasamy, and Nelliyat, 2003); agricultural or urban supply security (Crase, Dollery, and Byrnes, 2008); or vital public services (such as power generation and fire suppression) (Nuzzo, 2006).

In international law, water security has two conventional, relatively narrow, definitions (Tarlock, 2008). The first is a judicially or diplomatically enforceable water right; in other words, water rights security. The second is a "physically dependable supply" (Tarlock, 2008); or water supply security. Lately, concerns of uncertain supplies and access to supply has produced a new definition of water security in international law which Tarlock (2008) articulates as "water insecurity an unacceptable risk" to food production and human health that could result in "social insecurity or violence" (Tarlock, 2008). Otherwise stated: there is a "heightened fear of the drastic consequences of an inadequate supply" (Tarlock, 2008). Effectively, the new definition melds the two traditional definitions of water security, by requiring international law to both "fairly define the rights of respective states to set the outer limits of the use of the resource" and participate in the development of adaptive management institutions to facilitate interstate cooperation (Tarlock, 2008). Unfortunately this definition of water security fails to consider ecosystem needs and national water security belies possible insecurity at the community or watershed level.

The geopolitical nature of water security has been addressed in the academic literature within the discipline of political science. There, the context for water security is national, militaristic, environmental, and human security (Brauch, 2007). More specific discussions of environmental security suggest a long-standing preoccupation of states with water security (Anderson, 1992). In this same vein is a literature that hypothesises natural resource scarcity, including water scarcity (or water insecurity), may cause violent conflict (Yoffe, Wolf, and Giordano, 2003; Warner and Johnson, 2007) or greatly impact regional political stability (Giordano, Giordano, and Aaron, 2002).

Hydrological scholars have developed a suite of indicators of water insecurity and water scarcity from which a definition of water security might be derived. Water insecurity is a condition caused by either water scarcity or risk of inundation that can be attributed to an inability to manage water. An individual is water insecure when she lacks access to safe and affordable water to satisfy her needs for drinking, washing, and livelihood (Rijsberman, 2006). An area is considered water scarce if the community experiences water insecurity for a significant period of time. According to Falkenmark (1998) water scarcity can denote "a situation where demand, including basic human needs, exceeds supply" which can be attributed to "technological shortcomings, lack of purchasing power and/or lack of conducive institutions" (Falkenmark and Lundqvist, 1998). In summary, water scarcity has multiple definitions depending on the definition of need (human and/or environmental), resource availability (technology), and the temporal and spatial scale of analysis (Rijsberman, 2006).

Following the terrorism events of September 11, 2001, a particularly narrow definition of water security focused on drinking water emerged in the United States. First, United

States federal law made "drinking water infrastructure security…'a cornerstone of homeland security'" (Shermer, 2005). In implementing this concept, water engineers developed an understanding of water security as "guns, gates, and guards" to ensure potable water and drinking water infrastructure security (see especially the *Journal American Water Works Association*) (Staudinger, England, and Bleckmann, 2006). The US Environmental Protection Agency leads research on water security – prevention and protection against contamination and terrorism – that water utilities are keen to implement (Crisologo, 2008; Morley et al., 2007; Minamyer, 2008). In Australia, water security is still understood as security of water storage (supply) by engineers as "[E]very capital city except Darwin has considered building at least one desalination plant as a means of providing water security after several years of unprecedented drought that has significantly reduced dam storage levels" (El Saliby et al., 2009).

Definitions of water security in the policy realm are as variable as in the academic literature, and (unsurprisingly) tend to reflect the orientations of the sponsoring organisations. UNESCO-Institute for Water Education advocates an infrastructure and systems approach to water security which "involves protection of vulnerable water systems, protection against water related hazards such as floods and droughts, sustainable development of water resources and safeguarding access to water functions and services" (Unesco-Ihe, 2009; United Nations Environment Programme, 2002). In contrast, an agricultural focus to water security has been adopted by the Food and Agricultural Organization, which conceives of water as an input to agricultural production and thus food security ("crop water security") (Fao Land Division and Development, 2000). The World Economic Forum (WEF), while stressing the potential economic impacts of ignoring it, defined 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 Water Initiative, 2009).

Each of these policy definitions captures important elements of water security, but remains grounded in the typically fragmented concerns that characterise conventional water management paradigms. Even those papers citing broad definitions of water security can, in fact, take a rather narrow approach to water security. For example, water security in the development literature is understood as the ability to harness the productive potential of water and to limit its destructive impact (Grey and Sadoff, 2007). While the proffered definition of water security is, on its face, quite broad– "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments, and economies" (Grey and Sadoff, 2007) – the application demonstrates it is less so. The authors use three typologies to divide countries: those that have harnessed hydrology; those that are hampered by hydrology; and those that are hostage to hydrology. They suggest that countries, such as Canada, that have successfully harnessed hydrology have achieved water security. But the authors fail to consider accessibility and scale in their definition: country water security does not ensure accessibility throughout the country or watershed level water security[1]. A true picture of

[1] The Falkenmark Indicator, developed in the 1980s, remains widely used to measure the amount of water available in a country as a function of population, i.e. country water stress (Mccaffrey, 1997; Biswas, M.R., 1999; Rijsberman, 2006; Gleick, Chalecki, and Wong, 2002-2003). The indicator has four stress levels based on estimates of water requirements in the household, agricultural, industrial and energy sectors, and the needs of the environment. (Gleick, Chalecki, and Wong, 2002-2003; Rijsberman, 2006). Some degree of water scarcity, and thus water insecurity (for it coexists with water scarcity), exists when less than 1700 m^3 of renewable water resources per capita per year are available. However, making determinations of water availability (and stress or insecurity) at a national level can "hide important scarcity at smaller scales" (Rijsberman, 2006):7.

water security requires assessment at multiple scales from the local to the national for human and ecosystem needs.

The preceding discussion demonstrates that narrow definitions (both policy and academic) of water security may be the subject of critique. One issue is that narrow definitions fail to integrate the multiple stressors that result in water insecurities. A second set of critiques focuses on the bias in specific definitions of water security (for example, an over-emphasis on drinking water, while failing to recognise the links between environmental and drinking water quality). There is, of course, an advantage in narrow definitions, as they enable precise identification and assessment of specific issues of concern[2]. While recognising this advantage, we argue below that narrow definitions of water security constrain water management options,[3] and that broad definitions of water security are more consistent with the already well-established management tool of IWRM. Further, we consider that a broad definition of water security will facilitate integrative resolution of water insecurities in much the same way as has been the case with human security (Ewan, 2007).

Broad Definitions of Water Security

At the turn of the century Peter Gleick (2000) argued that a more comprehensive approach to water management – one that considers the impacts of water policy – was emerging (Gleick, 2000). The new approach to water management is characterised by the need to meet both basic human and ecosystem needs; improved efficiency and allocation; increased integration of issues and sectors; participatory management and collaborative decision-making; decentralised and more flexible management approaches/adaptive management; improved use of economic principles (full cost accounting); flexibility in new supply sources (desalination, reclamation); and consideration of human behaviour (Pahl-Wostl et al., 2008; Gleick, 2000). Against this backdrop of debates over new approaches to water management broad definitions of water security have emerged.

Academic papers using a broad definition of water security frequently cite either the GWP definition or offer a similar definition that includes human and ecosystem needs, accessibility, continuity, and affordability. For example, the Guelph Water Management Group defines water security as "a multi-dimensional concept that recognises that sufficient good quality water is needed for social, economic and cultural uses while, at the same time, adequate water is required to sustain and enhance important ecosystem functions" (De Loe et al., 2007).

Discussions rooted in the Ministerial Declaration understanding of the concept of water security often do not provide a definition of water security, but rather allude to one or all of the challenges articulated by the declaration. Dissecting the Ministerial Declaration for a statement on the implications of water security, one paper with an IWRM focus finds that

> Water security implies ensuring that: [F]reshwater, coastal and related ecosystems are protected and improved; [S]ustainable development and political

[2] For example, the specific concern of security of access to drinking water supply in developing countries is best articulated by the water poverty index (WPI) (Sullivan, 2002). Many of the other definitions of water security do not explicitly address access, perhaps indicating a developed world bias in which water access is taken for granted owing, in part, to well-developed infrastructure.

[3] This critique is analogous to narrow definitions of environmental security – as environmental degradation and national security – which constrain our ability to address environmental concerns.

> stability are promoted; [E]very person has access to enough safe water at an affordable cost to lead a healthy and productive life; and [T]he vulnerable are protected from the risks of water-related hazards (Savenije and Van Der Zaag, 2008).

From this list a reasonably broad definition of water security can be gleaned – access and affordable water of sufficient quality for ecosystem and human health as well as protection from water-related hazards (which is essentially infrastructure).

In discussing the key determinants of sustainable water security that would form the basis of a Global Water Convention to ensure cooperation on water management as has been done for climate and biodiversity, one paper draws on the GWP definition stating that sustainable water security "involves the availability of water in adequate quantity and quality in perpetuity to meet domestic, agricultural, industrial and ecosystem needs" (Swaminathan, 2001). While accessibility and affordability are not specifically mentioned, availability could be interpreted as a proxy for both in this definition. Although scale is not included in the definition, the author articulates specific activities for different levels (or scales) of government as being critical in the pursuit of water security.

Although she provides no definition of water security, Falkenmark (2001) articulates the linkages that are fundamental to water security noting that:

> [W]ater security is linked to a safe water supply and sanitation, water for food production, hydrosolidarity between those living upstream and those living downstream in a river basin and water pollution avoidance so that the water in aquifers and rivers remains usable, i.e. not too polluted for use for water supply, industrial production, agricultural use or the protection of biodiversity, wetlands and aquatic ecosystems in rivers and coastal waters (Falkenmark, 2001).

Implicitly, water security is an adequate quantity and quality of water for human and environmental uses, with some consideration of access and sustainability on a watershed scale. Hydrosolidarity is a concept that emphasises integration of water management across political boundaries alluding to the importance of governance in water security (Falkenmark, 1999). Mirumachi (2008) echoes Falkenmark's concern with governance:

> Because the scope of threats is wide in the concept of water security, it requires not only the state to protect its people from threats but also the involvement of other actors such as international organizations, non-governmental organizations (NGOs) and local communities. Thus, water governance by various stakeholders is a crucial component of ensuring water security (Mirumachi, 2008).

Although we argue that broad definitions of water security will facilitate integrative resolution of water insecurities, such definitions do present pitfalls and risks. Arguably, no definition is broad enough, as participants at a recent workshop noted they would want a definition of water security to include further dimensions including temporal, regional, international, and holistic. As well, some participants recommended specific mention of ground water and atmospheric water (Program on Water Governance, 2009). This highlights that despite a broad approach, it may not be possible to capture everyone's understanding of the concept. Moreover, a broad definition does not necessarily make the concept easier to apply, as it may not provide guidance on how to adjudicate competing demands (Program on Water Governance, 2009). Nonetheless, it is our contention that a broad definition water security is instrumental in overcoming water insecurities, but that it must be applied within a framework of good governance that will permit various stakeholders to raise issues of concern and facilitate adjudication of competing demands.

The emergence of the term "water security", and the tension between narrow and broad definitions of this term, shares a common trajectory with environmental security debates. Initially narrowly conceived, environmental security was cast as a limb of traditional military security (cf.(Kaplan, 1994) in which environmental degradation would lead to national and international insecurity. Pursuing this thesis, Thomas Homer-Dixon found that a more useful way to investigate the impact of environmental degradation was to focus on "how environmental stress affects *violent* national and international conflict" (emphasis supplied)(Homer-Dixon, 1999). A broader conception of environmental security contests the nation state as the referent and instead focuses on securing the integrity of the environment, separate and apart from concerns of the nation state (Dalby, 2002; Barnett, 2001). This broader conception has argued that good governance is integral to the pursuit of environmental security (Barnett, 2001).

In advancing a broad definition of "water security" we emphasise that the focus is on the integrity of water systems for human and environmental needs and that this goal is best achieved through governance that is inclusive, transparent, and accountable. We suggest that a key piece of the governance puzzle for water security is IWRM.

Water Security & Integrated Water Resources Management

What is the (potential) link between water security and Integrated Water Resources Management (IWRM)? The latter, of course, has "become *the* discursive framework of international water policy" (Conca, 2006). The concept of IWRM was formally recognised at the International Conference on Water and the Environment in Dublin in January 1992. With the incorporation of the Dublin Principles into Agenda 21, by the end of the 20th Century, "the idea of IWRM had emerged as the dominant paradigm by which to view and discuss water policy issues in an international context" (Conca, 2006).

Despite its ubiquity, there is little agreement amongst scholars or practitioners as to the meaning of IWRM. It has been broadly and variously defined, making it difficult to disagree with, and susceptible to frequent employ by various interests for all manner of arguments. The Global Water Partnership definition of IWRM may be the best known: "a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems" (Global Water Partnership, 2000, 2008). This definition is broad, taking into account water and land resources and social and economic welfare while maintaining (vital) ecosystem health. However, it does not set any goals or give any guidance as to how one might implement the process of IWRM. Some definitions of IWRM appear less broad because they do not specifically consider ecosystem health, e.g., "the unified or holistic management of water, land and other natural resources within the boundaries of entire river basins, watersheds or catchment areas" (Watson, 2007). Arguably, "holistic" management may include management for ecosystem sustainability that requires a reading into the definition.

With little consensus on what IWRM is or what ought to be integrated into the concept, it is unsurprising that IWRM "has rarely, if ever, been achieved in reality" (Watson, 2007). A number of reasons for the failure to implement IWRM have been posited including: insufficient capacity in the water sector, insufficient financial support, and reticence of policy makers to integrate issues (Jonker, 2007). Furthermore, Jonker (2007) argues that the failure to implement IWRM can be attributed to the fact that the concept is unclear and "that the GWP definition does not provide the theoretical clarity required to practitioners for successful implementation (Jonker, 2004)" (Jonker, 2007). Returning to the GWP definition of IWRM we find an umbrella concept: IWRM is a process in which the competing uses of water are to be balanced in a sustainable manner. It is necessarily vague because the balance for sustainability will be different in different jurisdictions. Perhaps more saliently, a determination of effective IWRM implementation is not possible,

because goals are so rarely associated with it. If clear goals are not articulated, it is difficult, if not impossible to determine if the process has been effectively implemented. Mitchell (2004) recognised this and called for "a systematic set of criteria against which to assess IWRM" (Mitchell, 2004). Arguably, there is little utility in developing a systematic set of criteria for a concept that has no common meaning. Conca (2006) makes a further critique of IWRM arguing that it is a "framework based on authoritative expert knowledge and transnational professional networking" which has struggled to incorporate civil society (Conca, 2006). The top down imposition of IWRM by technical experts, violates well-established principles of good governance, thus the failure to effectively implement IWRM is far from surprising.

One result of these critiques has been an increasingly "polarised discourse" of IWRM between two dominant approaches: the highly techno-centric approach and the Habersmasian approach of communicative rationality that facilitates integration of all decisions in an hydrological unit (Saravanan, Mcdonald, and Mollinga, 2009). Saravanan et al. (2009) argue that the two theories are complementary and that the GWP definition of and approach to IWRM needs to be revisited in order to facilitate sustainable water resource management (Saravanan, Mcdonald, and Mollinga, 2009). Indeed, current debates are fraught about the nature of IWRM: "the water management regime for the 21st century" (Jonker, 2007); a process (Mitchell, 2004); a management system (Dukhovny, 2004); or an instrument of water management (Biswas, A. K., 2004). We argue, instead, that viewing IWRM as a method of water management may facilitate movement beyond this "polarized discourse". In this way, IWRM is a critical tool for water management (Watson, 2007), but it is not a goal or outcome to be measured (Mazvimavi et al., 2008; Biswas, A. K., 2004).

From this perspective, a broad definition of water security is potentially complementary to IWRM. The concept of water security implies an outcome or goal, which can be formulated in specific terms (e.g. as a threshold). The concept of water security also creates a normative justification for integration: the assertion that environmental health and human health are mutually interdependent. This, in turn, implies the need for a comprehensive water governance and management regime in which IWRM is a significant tool. To illustrate these points, we examine the case of one jurisdiction that is working toward implementing such a regime: Ontario, Canada.

A WATER SECURITY APPROACH: ONTARIO, CANADA

In this section we present a case study of emerging approaches to water security in Ontario (Canada's most populous province). Significant changes in water governance and management have occurred in Ontario (and indeed in a number of jurisdictions) over the past fifteen years (Furlong and Bakker, 2010; Bakker, K. and Cameron, 2005; Gleick, 2000). Governance and management innovations have included consideration of both basic human and ecosystem needs; improved efficiency and allocation; increased integration of issues and sectors; adoption of participatory management and collaborative decision-making; delegation; adaptive management; implementation of economic principles (full cost accounting); innovation in supply sources (desalination, reclamation); and consideration of human behaviour (Pahl-Wostl et al., 2008; Gleick, 2000). Associated with these changes is a "market environmentalist" approach to resource governance (Bakker, K.J., 2004). Characterised by privatisation, commodification, and commercialisation, the market environmentalist paradigm holds that "where possible environmental ends are best achieved by market means" ((Bakker, Karen, 2005; Furlong and Bakker, 2010). In a market environmentalist approach to water management, economic efficiency is prioritized over social equity, planning is focused on demand management and scarcity, infrastructure is managed and/or owned the private sector, and regulations are developed using market derived techniques (Bakker, K.J., 2004; Furlong, 2007).

There are two events that give important context to the turn toward water security in Ontario. The first was the neoliberal 'revolution' of the Harris government from 1995 to 2002 that produced legislation that began the restructuring of municipal water governance in Ontario (Furlong, 2007). The second was the Walkerton Crisis and the legislation produced as a result of the subsequent inquiry. In 2000, seven people died in Walkerton, Ontario due to *E. coli* contamination of the town's water, precipitating a large-scale inquiry. The Walkerton Inquiry produced a comprehensive two part report that emphasised the need for Ontario to implement a multi-barrier approach to ensure drinking water security (Walkerton Inquiry and Ontario Ministry of the Attorney General, 2002a, 2002b). In response, Ontario overhauled its water legislation to implement a framework for the multi-barrier approach. This framework is, arguably, the most comprehensive water security strategy in Canada. While much of the framework remains to be implemented, we argue that, in Ontario, water security is emerging in the context of broader shift toward market environmentalism.

Table 1 Key aspects of water security as implemented in Ontario

Key aspects of water security	**Example from Ontario (date initiative commenced)**
Watershed approach	Conservation Authorities (1946); Source Protection Areas & Regions (2007)
Integration of land and water use planning (with water protection needs "trumping" land use)	Source Protection Regions (2007); Grand River Conservation Authority & Region of Waterloo (1990s)
Integration of ecosystem and human health concerns	*Clean Water Act, 2006* (2006)*; Drinking Water Ontario, Safe Drinking Water Act, 2002* (2002)
Integrated assessment of stressors and effects	Ontario Regulation 387/04 *Water Taking* (2004), O.Reg. 169/03 *Ontario Drinking Water Quality Standards* (2003)
Demand management	Ontario water conservation strategy (2009)
"Sustainable" accounting and pricing (e.g. life cycle accounting, full cost pricing)	Full life cycle cost accounting; full cost pricing; *Sustainable Water and Sewage Systems Act, 2002,* S.O. 2002, c. 29 (2002)

Key Aspects of Water Security in Ontario

Watershed approach

The watershed approach is a key aspect of water security because it facilitates participatory management, collaborative decision-making and delegation (Gleick, 2000; Pahl-Wostl et al., 2008). Ontario adopted the watershed approach to address interrelated land and water management issues in 1946 when the provincial legislature passed the *Conservation Authorities Act*[4] (Shrubsole, 1996). The act set out a framework, that has since been reviewed and adapted several times, for local authorities and the province of Ontario to work together on water management through various agencies. Watershed management has been within the purview of the Ministry of Natural Resources with

[4] R.S.O. 1990, c. C.27.

conservation authorities (CAs) responsible for implementation (Fitzgibbon and Plummer, 2004). More particularly, a CA is meant "to establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals."[5] Issues of drinking water have largely been taken up by municipalities who are responsible for drinking water service delivery under the oversight of the Ontario Ministry of Environment. This division of responsibility for water issues persists and presents a continuing challenge for integration of land use planning and water management in Ontario as will be discussed further below.

The *Clean Water Act, 2006*, imposes another tier of management on the long-standing conservation authority, watershed-planning framework. The area over which a conservation authority has jurisdiction is a source protection area and, therefore, the CA is a source protection authority. Some source protection authorities have been grouped together into source protection regions under a lead authority (one of the source protection authorities).[6] For example, the Lake Erie Source Protection Region is comprised of four SPAs: the Grand River SPA (lead authority), Long Point Region SPA, Catfish Creek SPA, and Kettle Creek SPA (Lake Erie Source Protection Region, 2008). The lead authority is to assist and provide resources to other source protection authorities in the region, as well as liaise with the Ministry of the Environment.[7] Among the key reasons for creating source protection regions was to simplify involvement for a number of municipalities that have territory within two or three of the source protection authorities (and therefore conservation authorities) (Lake Erie Source Protection Region, 2008). As a result of the SPA groupings most municipalities are within SPA. While this new tier in Ontario's water management framework may improve the process for municipalities, the impact for CAs remains to be seen. CAs now have relationships with both the Ministry of Natural Resources (*Conservation Authorities Act*) and the Ministry of Environment (*Clean Water Act, 2006*). At the very least, implementation of source protection regions will result in "redefinition of previous watershed authority responsibilities and relationship" (Fitzgibbon and Plummer, 2004).

Integration of land use planning and water management

Since land use can have significant impacts on water quality and quantity, integration of land use planning and water management is critical to water security. Such integration has been elusive in Ontario (Fitzgibbon and Plummer, 2004). Traditionally, municipalities have limited their water management concerns to provision of drinking water and waste water systems. Watershed management is the purview of conservation authorities that are directed "to manage surface water flows and regulate floodplain protection, are intended to play key organizational, review, and support roles in source protection planning in Ontario" (Ivey, De Loe, and Kreutzwiser, 2006). CAs are comprised of the territories of several municipalities[8] (or parts of municipalities) that have considerable jurisdiction over land use planning. Municipal land use planning powers are granted under the *Planning Act*[9] which also requires municipalities develop and implement 'official plans' "which set out goals and policies to direct development and consider associated impacts on the social, economic, and natural environment of the municipality" (Ivey, De Loe, and Kreutzwiser, 2006). Official plans are one of the main ways in which

[5] *Ibid.* s. 20(1).

[6] O.Reg 284/07 *Source Protection Areas and Regions*

[7] *Clean Water Act, 2006,* S.O. 2006, c.22, s.6(2).

[8] Ontario's two-tier municipal system means that only regional municipalities are participating municipalities in conservation authorities *Conservation Authorities Act*, R.S.O. 1990, c. C.27.

[9] R.S.O. 1990, c. P. 13.

municipalities and conservation authorities collaborate as CAs "provide…input and review to municipal Official Plans and planning processes to the majority of Ontario's municipalities" (Hibma and Pearson, 2008).

The Grand River Conservation Authority and the Regional Municipality of Waterloo have achieved a uniquely high level of integration of land use planning and water management through a variety of policies and activities (Ivey, De Loe, and Kreutzwiser, 2006). The successful integration of land use planning and water management in the Regional Municipality of Waterloo has been attributed to "the Region's strong political commitment to integration, good working relationships with other organizations (e.g., GRCA, other municipalities), and access to adequate financial and staff resources" (Ivey, De Loe, and Kreutzwiser, 2006). Waterloo's initiatives and achievements predate the source water protection program and represent effective use of existing municipal tools. As such, it remains to be seen if implementation of Waterloo-type initiatives would be feasible under the new program.

The new source water protection program is still in development,[10] but draft documents detail seven policy approaches to reducing risks posed by drinking water threats (Source Protection Programs Branch, 2009). Four of the approaches are well-established: education and outreach programs; incentive programs; land-use planning approaches and, new or amended provincial instruments. The remaining three approaches have considerable potential power. They are risk management plans; prohibition; and restricted land uses to be used in certain, limited circumstances (Source Protection Programs Branch, 2009). The restricted land use powers found in section 59 of the *Clean Water Act, 2006* (CWA) are not to be used "as a stand-alone approach to reducing the risk of significant threat activities" (Source Protection Programs Branch, 2009). In order to use the risk management plan and prohibition provisions,[11] the CWA regulations must prescribe the activity at issue (Source Protection Programs Branch, 2009). In other words, if the activity is not recognised as a threat in the CWA regulations then none of the three additional policy tools may be used. Thus, a threat that emerges after the regulations have been prescribed will not be subject to any of the three new approaches, unless and until the regulations are modified. This restricts communities' ability to respond to emerging threats – to be adaptive – and potentially increases water insecurity.

Integration of ecosystem and human health concerns

To successfully address either ecosystem or human health concerns – the goal of water security – requires integrated planning since they are interdependent outcomes (Fitzgibbon and Plummer, 2004). Watershed planning in Ontario has tended to focus on management of the ecosystem and management processes rather than on ecosystem health. Post-Walkerton Ontario's new legislative framework is driven primarily by human health concerns. Making protection of drinking water sources the main purpose of the *Clean Water Act, 2006*[12] underscores this point. Taking up this mandate, the Ministry of Environment created *Drinking Water Ontario* a portal on its website that serves as a clearinghouse for public information on drinking water in Ontario (Ontario. Ministry of the Environment, 2009a). The portal profiles Ontario's "Drinking Water Safety Net" a framework that admits to eight key features: source-to-tap focus; a strong legislative and regulatory framework; health-based standards for drinking water; regular and reliable testing; swift, strong action on adverse water quality incidents; mandatory licensing, operator certification and training requirements; a multifaceted compliance

[10] Source water protection regulations under the *Clean Water Act, 2006,* were expected in late 2009 (at time of submission had not been released) and are meant to formalise the program.

[11] *Clean Water Act, 2006,* ss.57, 58.

[12] *Ibid.* s.1

improvement toolkit; and partnership, transparency and public engagement (Ontario. Ministry of the Environment, 2009b). All of this reinforces the focus on human health. Considerations of ecosystem health are, at best, an afterthought in Ontario.

Integrated Assessment of stressors & effects

Central to the water security mission is a consideration of both basic human and ecosystem health – in other words sufficient quantity and quality of water. Implementation of assessment tools for monitoring stressors and effects of water security has been a major innovation (Dunn and Bakker, 2009). Ontario Regulation 387/04 *Water Taking* introduces a set of indicators for assessment of stressors regarding water quantity. Under the regulation, the Minister of Environment is obligated to consider specific water availability issues prior to issuing a Permit To Take Water (PTTW). The issues to be considered include: "the impact of the water taking on water balance, sustainable yield and existing specific uses of water (including municipal water systems, sewage disposal, agriculture and private domestic); water conditions (e.g. droughts); watershed current use (e.g. areas already identified as "high use"); and planned municipal use" (Garfinkel et al., 2008). The PTTW scheme is intended to address the cumulative effects of a number of withdrawals in a watershed. However, critics note the qualified nature of the mandatory consideration of water availability and the complaints-based nature of the PTTW scheme that, in effect means that cumulative effects go unnoticed unless complained about by other water users (Garfinkel et al., 2008). The effect of a complaints-based system is that by the time another water licensee reports a reduction in her quantity, the watershed's hydrological integrity has likely already been affected.

The *Safe Drinking Water Act, 2002*, and its regulations addressed a number of the barriers envisaged by the Walkerton Inquiry Report by introducing "binding standards, enhanced operator certification, requirements for laboratory certification, source water protection, and public notification if drinking water is unsafe" (Hill, 2006). Ontario Regulation 169/03 *Ontario Drinking Water Quality Standards* sets out the specific microbiological, chemical, and radiological standards for drinking water quality. A program to ensure safe drinking water must do more than focus on direct measurement of water quality because to do so necessarily results in reactive responses – most water quality monitoring tests are not useful indicators of effects because they cannot be done in real time. In other words, relying on such tests necessarily means contamination could be present in the system for a number for hours prior to a response from public officials. Instead, the use of proxies is recommended for a preventative and proactive approach to assessment that ensures the drinking water system functions as designed in a continuous manner (Hrudey, S. E. and Hrudey, 2004). The Walkerton Inquiry Report (2002b) detailed the major features of such a preventative approach – often known as a total quality management system – for management and operation of Ontario drinking water systems. They include the adoption of best practices and continuous improvement; 'real time' process control (e.g., the continuous monitoring of turbidity, chlorine residual, and disinfectant contact time) wherever feasible; the effective operation of robust multiple barriers to protect public health; preventive rather than strictly reactive strategies to identify and manage risks to public health; and effective leadership (Walkerton Inquiry and Ontario Ministry of the Attorney General, 2002a).

Subsequent to the Walkerton Inquiry, Hrudey et al (2006) have noted the value of good governance (namely, transparency, accountability, and inclusiveness) to a total water quality management framework citing an Australian example which "provide[s] consumers with the means for judging whether their water provider is functioning as safely and effectively as circumstances reasonably allow" (Hrudey, S.E., Hrudey, and Pollard, 2006).

Table 2: Key water legislation in Ontario and its general purpose(s)

Year	Legislation	General Purpose(s)
1997	*Municipal Water and Sewage Transfer Act*, *1997,* S.O. 1997, c. 6, Sched. A	To transfer ownership of water and sewage facilities to municipalities; and to transfer responsibility for the provision of water and sewer services to municipalities
2002	*Safe Drinking Water Act, 2002,* S.O. 2002, c. 32	To recognise that the people of Ontario are entitled to expect their drinking water to be safe; to provide for the protection of human health and the prevention of drinking water health hazards through the control and regulation of drinking water systems and drinking water testing
2002	*Sustainable Water and Sewage Systems Act, 2002,* S.O. 2002, c. 29	To require municipalities to report on full cost of water and waste water services
2006	*Clean Water Act, 2006,* S.O. 2006, c. 22	To protect existing and future sources of drinking water

Sustainability: the drive for efficiency

The market environmentalist paradigm of resource governance underlies a variety of ongoing reforms in water governance in Ontario. Many of these reforms are the result of two waves of legislative reform. The key statute in the first wave, the *Municipal Water and Sewage Transfer Act*, *1997*,[13] transferred responsibility for water and sewage services from the provinces to the municipalities thereby driving them to pursue efficiency—in the form of economic and infrastructure sustainability. Efficiency (doing more with a given quantity of water) has been more widely implemented than conservation (using less water by managing demand) in Ontario municipalities (Furlong, 2007). Typical approaches to efficiency include improving infrastructure and applying technological improvements such as low-flow water appliances. Conservation generally requires changes in water user behaviour. While each of these are important pieces in the sustainability puzzle, the debate between them often overlooks issues of social equity, especially when pricing water services is considered a solution (Furlong, 2007).

The second wave of legislation overhauled Ontario's legal framework for water in response to the Walkerton Crisis. The three main statutes in this wave were designed to implement the Walkerton Inquiry's recommendations for a multi-barrier approach and at the same time further entrench the earlier wave's efficiency mandate. A key example of this is the *Sustainable Water and Sewage Systems Act, 2002*, which, although not yet in force, requires municipalities report the full-cost accounting for their water and waste water systems.[14]

[13] S.O. 1997, c. 6, Sched. A.

[14] In December 2009, the governing Liberals introduced Bill 237 - *Sustainable Water and Waste Water Systems Improvement and Maintenance Act, 2009*. If passed the bill would enact the *Sustainable Water and Waste Water Systems Improvement and Maintenance Act, 2009,* establish

Although frequently found in both policy and academic literature, water sustainability is rarely explicitly defined, but according to the UN requires the balancing of economic, ecological, and social components in development of a community's water resources (United Nations 1987). In Ontario, water sustainability has been conceived of in terms of security, such as the Source Water Protection program developed pursuant to the *Clean Water Act, 2006,* the purpose of which is "to protect existing and future sources of drinking water".

Recent developments suggest Ontario is broadening its approach to sustainability. In the fall of 2009, the Ontario Ministries of Environment and Natural Resources issued a proposal paper for "safeguarding and sustaining Ontario's water resources for future generations" (Ontario. Ministry of the Environment & Ministry of Natural Resources, 2009). The paper presents options and proposals for water conservation and efficiency, managing intra-basin water transfers, and implementing phase two of the permit to take water program. Notably, in Ontario, sustainability and safeguarding – or securing – seem to be twin mandates.

CONCLUSIONS: ECOLOGICAL GOVERNANCE & WATER SECURITY

As we have argued above, the strength of a broad definition of water security lies in its ability to set normative goals or outcomes for water management, which can be formulated in specific terms (e.g. as a threshold). The concept of water security also creates a normative justification for integration: the assertion that environmental health and human health are mutually interdependent. From this perspective, a broad definition of water security is potentially complementary to IWRM.

Broad definitions of water security, which we have advocated in this paper, share a common trajectory with emerging debates over "ecological governance". This framework (and there are many others like it, with different labels) is based on two central claims.[15] First, in order to achieve sustainability, human activity should be understood as occurring within, and as an integral part of ecosystems. Second, recognising the interrelationship between humans and the environment requires that we evolve alternative, ecologically sensitive systems of governance.[16]

Various disciplines have attempted to formulate terms with which to describe this interrelationship. Economists and social scientists speak of the health benefits of clean

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the Ontario Water Board and repeal the *Sustainable Water and Sewage Systems Act, 2002*. At first reading, MPP David Caplan stated:

"This bill will promote clean, safe drinking water, ensuring Ontario is strong, healthy and prosperous. The bill evolves from Justice O'Connor's recommendations from the Walkerton inquiry and from the recommendations of the water strategy expert panel's report.

This bill does a number of things. It ensures the public ownership of water and waste water systems. It promotes financial sustainability. It improves transparency in the provision of water and waste water services to the public. It mandates full metering, and it creates an independent economic regulator with the expertise and authority to administer the act.

The act brings into broad daylight the often hidden water and waste water services. Well-maintained and well-functioning water and waste water systems indeed underpin our very quality of life. This legislation will help Ontarians continue to enjoy high standards of public water services that are affordable and sustainable for generations to come" (Ontario, Legislative Assembly, 2009).

[15] The "New Culture of Water" paradigm, which originated in Spain in the mid-1990s in response to a planned wave of mega-dams and hydraulic projects, is one example. The main force behind the popularization of the paradigm is Pedro Arrojo, a Spanish academic and winner of the Goldman Environmental Prize.

[16] There is a range of works within the field of political ecology, which develop similar perspectives. For a discussion of "ecological governance," see (Gale and M'gonigle, 2000).

water as a "public good": non-rivalrous (in that one person's enjoyment of water-related health does not detract from another's), non-excludable (in that individuals can not be excluded from the collective benefits of public health), and non-substitutable. Natural scientists speak of water's circulation via the hydrological cycle (including through human bodies), and have coined the term "eco-hydrology" to describe the interactions between water and the environment. Political ecologists prefer the term "hydro-social" cycle, expanding this set of relationships to include the built (or "artificial") as well as "natural" environments, emphasising the fact that water connects individuals not only politically and socially but also materially. Again, religious traditions have a completely distinct set of terms, revolving around water's symbolic importance and sacred character. And scholars of the environment have coined terms like "ecological governance" (our preferred term). All of these perspectives attempt to capture the essence of water as an integrator of humans, non-humans, and ecosystems. To the extent that the concept of water security captures this integration, and enrols it as a strategy for improved water governance, it is indeed a promising water management paradigm for the 21st century.

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