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The Competition for Water:

Striking a Balance among Social, Environmental, and Economic Needs

Henning Bjornlund

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Faced with water scarcity amid rising demand from a growing economy and population, Alberta is a bellwether region on water management issues. Without a modern system for reallocating access to water, particularly from prior licence holders to new users, Alberta's economic development and its ecosystems could be threatened.

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The Study in Brief

With many water resources overcommitted and suffering environmental degradation, it is becoming urgent to find ways to reallocate increasingly scarce water supplies to meet rising demand and growing environmental concerns. In Canada, this challenge is nowhere better illustrated than in Alberta.

The province is home to 60 percent of all irrigation in Canada and has a fast-growing population and economy. These pressures helped prompt the province to halt the issuance of new licences for taking water from the Bow, Oldman and South Saskatchewan River sub-basins in 2006, bringing into focus the need to fulfill rising demand for industrial, urban, and environmental water use.

Without a reliable mechanism for transferring water access rights from prior holders to new users, Alberta's continued economic development and its ecosystems could be threatened.

This *Commentary* discusses how water markets could be used in the Alberta context and what supporting institutions would be necessary to enable them to operate efficiently. Indeed, urgent action is needed within the current legislative framework to enable a better distribution of water resources.

As a prerequisite for the efficient allocation of water among competing users, the most pressing task is for the Alberta government to define waters within each watershed that need to be protected to secure environmental and other public benefits. Reforms should also aim to improve existing licence structures and introduce mechanisms to encourage water markets to operate more efficiently.

Also needed is a focus on longer-term solutions, such as consideration of whether the current first-in-time-first-in-right property rights system is the most appropriate way to allocate and manage access to increasingly scarce water resources.

Although this study focuses on surface water and the South Saskatchewan River basin, and solutions to water resources management inevitably must be region specific, discussions in this *Commentary* could be adapted to other regions of Canada where water scarcity is a growing issue, including some watersheds in Ontario, the southern parts of the Prairies provinces, and in British Columbia's Okanagan Valley.

Water resources in many parts of the world are under increasing pressure. Escalating demand for water, fuelled by unprecedented population and economic growth during the past century, has led to intense competition for, and conflicts over, available resources.

To encourage irrigation, food production, and development, thousands of new dams and irrigation projects have been constructed and water supplied in generous volumes at little or no cost to users, often on relatively low-value commodity crops, unsuitable soils, and in inappropriate locations. In many places, this has led to serious environmental problems.

With many water resources overcommitted and suffering environmental degradation, it is becoming urgent to find ways to reduce the current level of extraction and to reallocate increasingly scarce water supplies to meet rising demand and growing environmental concerns. In many overextended basins, some 80 percent of the water is extracted for irrigation, but since irrigated farming is the economic engine of many rural regions, reducing access to water for this purpose in favour of urban and more environmentally friendly uses could have serious negative socioeconomic effects, including loss of farm revenue and subsequent decline in local business activity and job opportunities. It is imperative, therefore, that institutions and instruments facilitate the reallocation of water from low-value, inefficient uses in unsuitable locations to higher-value and more efficient uses in ways that minimize such effects on farmers and their communities.

Canada boasts some of the world's largest bodies of fresh water and many mighty rivers, but its water supplies are unevenly distributed. Water is abundant in Central Canada, along the West Coast and in the North, but the southern parts of the Prairie provinces are dry and water scarcity is emerging in British Columbia's Okanagan Valley and in some watersheds in Ontario. How should Canadians deal with this scarcity?

Alberta is a useful place to consider in assessing the available policy options since the province is home to 60 percent of all irrigation in Canada (Statistics Canada 2007) and has a fast-growing population and economy. These pressures contributed to Alberta's halting the issuance of new licences for the South Saskatchewan River basin, bringing into focus the need to fulfill rising demand for industrial, urban, and environmental water use. Although Alberta has made significant progress with new water legislation and its *Water for Life* strategy, positioning the province as a leader in water management, further improvements are necessary. This need was acknowledged in 2009 with the release of three reports: i) by the Minister's Advisory Group to provide advice on water management and allocation (MAG, 2009), ii) by the Alberta Water Council (AWC, 2009), and iii) by the Alberta Water Research Institute (AWRI, 2009).

This *Commentary* discusses how water markets could be used in the Alberta context and what supporting institutions would be necessary to enable them to operate efficiently. Indeed, urgent action is needed within the current legislative framework to enable a better distribution of water resources. As a prerequisite for the efficient allocation of water among competing users, the most pressing task is for the Alberta government to define waters within each watershed that need to be protected to secure environmental and other public benefits. Reforms should also aim to improve existing licence structures and introduce mechanisms to encourage water markets to operate more efficiently. Also needed is a focus on longer-term solutions, such as consideration of whether the current first-in-time-first-in-right property rights system is the most appropriate way to

The author was a member of the Minister's Advisory Group on Water Management and Allocation in Alberta. The views expressed in this paper are his own, however, and in no way reflect the views of the group. The work of the author is funded by the Alberta Water Research Institute, the Canadian Water Network and SSHRC in Canada, and the Australian Research Council in Australia.

allocate and manage access to increasingly scarce water resources. Although this study focuses on surface water and the South Saskatchewan River basin, and solutions to water resources management inevitably must be region specific, one hopes that the discussions in this *Commentary* can be adapted to other regions of Canada.[1] It is imperative, however, that policymakers do not postpone immediate reforms while considering longer-term solutions. Experience in other jurisdictions strongly suggests that the longer inevitable decisions are postponed, the more entrenched conflicts over water become and the more expensive it will be – in economic, social, and political terms – to introduce reforms. Finally, robust, sustainable water management and allocation processes must be able to adapt to changing climate conditions and community values.

The Alberta Context

Traditionally, water allocation in Alberta reflected the myth that water was plentiful: new water licences were issued whenever new users requested them, resulting in the area under irrigation increasing from 19,223 hectares in 1911 to 495,786 hectares in 2008, with the sharpest increase coming after 1970 (Alberta 2009). Until recently, water licences in Alberta were issued without term but were generally considered by licensees and lenders to be in perpetuity.[2] Licences are based on the first-in-time-first-in-right (FITFIR) principle, which prioritizes licence holders' access to water according to the date their licence was issued – that is, during periods of scarcity, the holders of older licences are entitled to receive their total licensed volume of water before holders of newer licences. There is increasing recognition, however, of the scarcity of water resources in southern Alberta, and over the past decade the provincial government has taken steps to change the way water is managed. For instance, the 1999 *Water Act* and the 2000 *Irrigation Districts Act* provided for the introduction of water allocation transfers and water assignments – the right to use a volume of water during a given season – from one licence holder to another.[3] (See Glossary of Terms on page 21.)

In November 2003, Alberta released a strategy paper, *Water for Life* (Alberta 2003a), acknowledging that, without changes, future demand for water to ensure continued economic growth, to support a growing population, and to secure healthy rivers and lakes is likely to exceed available supply. The strategy sets ambitious objectives to be achieved by 2015, such as a 30 percent increase in water use efficiency and productivity. The strategy assumes that the introduction of market-based instruments and best-management practices, public participation in watershed-planning processes, and the reallocation of water from existing users to meet anticipated increases in demand from industry, urban users, and the environment all will help to achieve its objectives. Alberta renewed its commitment to the strategy in 2008 (Alberta 2008), and in 2009, through the Alberta Water Council, all major sectors of the economy agreed to develop measurable water conservation plans and targets within the next two years to demonstrate how they expect to achieve the strategy's goals (Taylor 2009). The most water-intensive sector, the irrigation sector, released a draft report in June 2009 (AIPA 2009).

The urgency for policy reform was emphasized in the background papers to the Draft South Saskatchewan River Basin Management Plan (Alberta 2005), which notes that:

- 22 of 33 main Alberta rivers are suffering moderate environmental effects from increased water stress caused by current levels of water extraction for consumptive use, 5 more are suffering heavier environmental effects, and 3 are environmentally degraded;

1 Most of the issues discussed in this *Commentary* are also valid for groundwater resources, but space constraints do not allow one to address groundwater specifically.

2 Licences are now issued for a specified period of time.

3 Importantly, however, the assignment option does not mean that new users get access to water, since the transfers are limited to existing licence holders.

- demand from non-irrigation users could increase by 35 to 67 percent by 2021 and by 52 to 136 percent by 2046;
- districts under irrigation could expand by 10 percent and 20 percent in the Oldman and Bow River basins, respectively; and,
- the population in the South Saskatchewan River basin is expected to grow from approximately 1.3 million in 1996 to more than 2 million by 2021 and to more than 3 million by 2046.

The first practical consequence of the increased level of stress in the South Saskatchewan River basin occurred in 1991, when Alberta capped water allocations for irrigation. Continued stress, exacerbated by a 2001 drought, resulted in Alberta Environment's placing a moratorium on additional surface water licences for the southern tributaries of the Oldman River (Alberta 2003b). In 2005, the ministry announced it would no longer accept applications for new allocations from the Bow, Oldman, and South Saskatchewan River sub-basins until it could determine how water not currently allocated should be used (Alberta 2005). As a consequence, the extraction of surface water and hydrologically connected groundwater for all forms of consumptive use has now been capped.

Looking ahead, changing community values will increase pressure to retain more water in-stream for environmental, recreational, and cultural purposes. Under the *Water for Life* strategy, community-based Water Planning and Advisory Committees identify and advise the environment minister on water conservation objectives. Water conservation objectives are defined under the *Water Act* as the amount and quality of water necessary to protect the aquatic environment as well as recreational, tourism, transportation, and waste assimilation uses of water. Climate change is also likely to alter the distribution of precipitation, reduce snow melt, and increase evaporation (Schindler and Donahue 2006). All these factors will further increase water scarcity for consumptive use during periods of peak demand and strain water-management and allocation processes.

The province's largest extractors of fresh water are irrigators in the south, who, individually or as members of irrigation districts, control three-quarters of all allocated water (Alberta 2002), a large percentage of which is used to produce relatively low-value crops (AIPA 2002). With continued growth and diversification of the economy, increased demand for non-extractive uses, and decreased supply due to climate change, it seems inevitable that some of the water presently extracted by irrigators will have to be reallocated to other uses.

The *Water for Life* strategy stresses the key role of economic instruments in meeting water conservation and productivity objectives. It places a strong emphasis on respecting the rights of existing water users, which implies that no water user will be forced to give up water or to adopt certain management practices or water-use technologies. It further emphasizes voluntary processes, the development of education programs, improved public participation, and the use of market-based instruments.

While the pressure is clearly most urgent in the South Saskatchewan River basin, the water allocation mechanisms for northern rivers are also in need of reform. There, the problem is not to reallocate volumes of water among competing users within a closed basin; rather, it is to allow current and new users to gain access to water licences of a seniority that suits their risk profile and the vulnerability of their production to uncertain supplies. Given the nature of the FITFIR system, the need to reallocate water licences will emerge well before the need to close basins arises. In these basins, some users might want to obtain very senior licences to ensure supply during periods of the most severe scarcity and into the future; others might prefer an assortment of licences of different priority.

Alberta's Experience with Water Trading

Water trading has been an option in Alberta since 1999, but its uptake has been very limited. Only during the very dry season of 2001 did trading in assignments of the right to use water flourish and play an important role in reallocating water among competing agricultural users (Nicol and Klein 2006). Transfer of licensed water allocations

has never taken hold, and very few market transactions, representing "arm's-length" transfers between different users in exchange for money, have taken place. Most such transfers have been changes in the point of diversion to improve licence holders' ability to manage water, rather than changes of ownership. Analysis of the few "arm's-length" transactions conducted over the first five years since water trading was allowed indicates that sellers were selling water that they did not need, while buyers were purchasing water to secure more reliable access to water as the commodities they are producing are sensitive to timing and accuracy of application of irrigation water (Nicol, Klein and Bjornlund, 2008).

The reason for the low level of water trading seems to be that the process involves several lengthy stages of document and survey preparation and collection of data, as well as public and government review. While the actual cost of transfer is comparable with, and even on the low side of, international experience, would-be traders view the long time delays and uncertainty about the final outcome as major obstacles and they express a high level of frustration with the process. Traders further point out that it is not easy for buyers and sellers to find each other and even more difficult to establish a market price due to scarcity of information (Nicol, Klein and Bjornlund 2008). More generally, there is very little support for the use of market-based instruments within the irrigation sector. In a 2006 survey of managers and members of the boards of directors of the 13 irrigation districts, only 24 percent agreed with the use of market-based instruments, with 8 percent agreeing with the use of transfer of licensed water allocations and 15 percent with water assignments (Bjornlund, Nicol, and Klein 2007).

Since trading began, the largest single transfer has been to secure supply for a large new development at Balzac, north of Calgary. This transfer met with numerous protests and, even though it was beneficial to the Western Irrigation District – the seller of the water entitlements – it was approved by only a narrow margin (Nicol, Bjornlund, and Klein 2010). Indeed, in the wider community, trading has been viewed with great suspicion, with protests registered not only against the Balzac transfer but also against attempts to free up irrigation districts' ability to trade (see Droitsch 2007; Ecojustice and Bow Riverkeeper 2008). While some district licences, such as that of the St. Mary River Irrigation District, were amended in the past to allow districts to deliver water for non-agricultural purposes, when the Eastern Irrigation District applied in 2007 for similar amendments it was met with protests, and the provincial government halted the process pending the completion of further investigation. Opponents argued that allowing the district more transfer flexibility amounted to circumventing the rigorous assessments associated with the transfer of licensed water allocations.

Although the Alberta government's intentions to introduce market-based instruments are embedded in its *Water for Life* strategy, it has now stopped amending district licences to permit more flexible water management and use, including the ability to supply the non-irrigation sector. This may be shortsighted because such amendments could allow districts to supply cities and industries with water when not needed for irrigation without permanently relinquishing control over the water, which would be totally in line with one of the key objectives of the *Water for Life* strategy and increase the likelihood that irrigators would accept such transfers.

These examples of community conflict over water trading, combined with the clear recognition in the *Water for Life* strategy of the benefits of reallocating water to meet new demand, underscore the need for a new framework for water trading in Alberta.

The Move to Market Reallocation Mechanisms

In many regions of the world, water entitlements are established in a way that gives governments authority to reallocate water under certain conditions or within certain time intervals. In other places, legislative changes are required to provide governments such authority. Given sufficient political will, a centralized reallocation process could be used, but there are very few examples of this. In most jurisdictions, entitlements to water are perceived to be perpetual. Entitlement holders make significant investments to use the water, and the value of the

water is usually reflected in land prices and on farm or household balance sheets. Draconian reallocation of water using government powers therefore is likely to generate significant political costs and prolonged legal battles over compensation. Further, in both economic and political terms, it is difficult to define a set of criteria to determine which licence holders should have their licences cancelled/reduced, who to grant new licences to, how much to pay for cancelled licences and how much to charge for new licences. Accordingly, in many places, such as Australia, the southwestern United States, South Africa, and Chile, water markets are relied on to facilitate reallocation of water because they involve voluntary transactions between willing sellers and buyers where both parties consider they are better off after the transaction.

The shift toward treating water as an economic good – a good sold at a price – gained momentum with the Rio Convention and Agenda 21 in 1992 (see Sitarz 1993) and with the announcement by the World Bank of a new water policy in 1993, including the introduction of concepts such as full-cost-recovery water charges, privatization of the water industry, private property rights in water, and water markets (World Bank 1993). However, water is commonly perceived primarily as a social good – a non-priced good for everyone's benefit – to be allocated in pursuit of social objectives (see Appelgren and Klohn 1999). Hence, attempts to introduce market-based systems have met with opposition and even, in some cases, violence (Gunatilake and Gopalakrishnan 2002; Hall, Lobina, and de la Motte 2005).

In places where water markets have been introduced, two important, distinct sub-markets have developed. In one, the long-term entitlement to receive water allocations each season is traded – this has often been termed the "permanent market," the "water rights market," or, in Alberta, the "market for licensed water allocations." In the remainder of this paper, this market is referred to as the "entitlement market." In the second sub-market, the short-term right to use a certain volume of the seasonal allocation of water is traded, while the seller continues to own the long-term entitlement – this market is sometimes called the "temporary market," the "short-term market," the "spot market," or, in Alberta, "assignments" of the right to use water. In the remainder of this paper, this market is termed the "allocation market."

Water Market Challenges and Limitations

Despite the strong economic and political rationales for water trading, only a few countries have formally introduced water markets. In some developing countries, such as India and Pakistan, informal and, in many instances illegal allocation markets have been active. In other countries, such as Spain and Oman, variations of water trading have been used for a long time (Maas and Anderson 1978; Al-Marshudi 2007). Markets have been implemented in only a few countries for a number of reasons, which can be grouped under the categories of capacity challenges, community and social concerns, and public interest concerns.[4]

Capacity Challenges

Capacity challenges are associated with the need for complex institutional and governance structures, including:

- well-defined, secure, and enforceable entitlements to interests in water;
- secure registers of water entitlements on which transfers, mortgages and other third-party interests can be registered and enforced;
- metering devices to measure water use;
- monitoring and enforcement processes to protect interests in water and the integrity of the system;
- governance structures to protect public interests in water; and
- market processes and market intermediaries that communicate the supply of, and demand for, water and facilitate the transfer process.

4 See the Appendix for a more comprehensive and fully referenced discussion of international experience.

Provision of these systems requires extensive human and financial capital that is absent in many developing countries. And even in developed countries that can afford it, the political will is often not present.

Community and Social Concerns

The introduction of water markets is associated with a high level of community concern over their anticipated social and community effects and, therefore, such markets have always met considerable opposition. Farmers, in particular, have been reluctant to adopt water markets. They are concerned about the impact on their operations if substantial volumes of water are traded out of their supply system, fearing that the cost of water supply will go up and the long-term viability of their irrigation system will be challenged, that landowners who sell the water will leave land abandoned and uncultivated, and that water will be consolidated in major corporate entities or speculators who will control who get access to water at what price. Irrigators are concerned that substantial transfers of water out of their communities will result in losses of jobs and services and threaten the long-term viability of their rural communities. Such effects have been clearly identified in places, including in Australia and the United States. However, many would argue that these changes are an inevitable part of a structural adjustment process in agriculture and are likely to take place regardless of the operation of water markets. In fact, it has been argued (see Appendix) that water markets allow this structural adjustment to take place in a more orderly fashion, with those who choose to exit the industry departing in a better position. Nonetheless, the concerns of farmers and irrigators are serious and persistent and present an impediment to the adoption of water markets. In Alberta, the debate over the Balzac transfer and the amendment of district licences suggests that this is indeed a major issue.

Public Interest Concerns

Concerns about the public interest relate to securing water for public benefits, particularly to ensure adequate in-stream flows that support healthy ecosystems and that permit environmentally useful events such as flooding to encourage seed germination. Public benefits also include social and community needs, such as those discussed above, or water for recreational and cultural purposes. What is considered to be an adequate supply of water for public benefits has to be defined in accordance with local community values supported by the best available science. By themselves, markets likely cannot provide supplies of water adequate to ensure public benefits, since markets operate between individuals who seek to maximize their individual benefits.

Ensuring Water Markets Function Effectively

These capacity challenges and concerns need to be addressed by appropriate policy reforms in order for markets to operate effectively. In most societies, however, there has been a tendency to postpone major water reforms. Often, such delay is preferable because water management reform is associated with a high level of conflict among competing users, emotional debates, and significant community pain. Further, individual users usually have long-standing rights to water resources that, in many cases, are associated with substantial capital investments. Changing the way people can use and access such rights, therefore, can have serious socioeconomic effects on both resource users and the communities that depend on the resource as the engine of economic activity. International experience suggests, however, that it is actually a lot easier and cheaper in economic, social, and political terms to introduce water reforms before scarcity intensifies conflicts over access and use.

Experience from Australia suggests that water scarcity can emerge very quickly and drive urgent, and therefore often not properly considered, reforms. To manage increased scarcity, water markets were considered a key instrument. As a result, the number of transfers in some areas increased sharply over a period of a few years

during the late 1990s, from several hundred a year to more than 3,000. From 1993 to 2004, market participation increased from less than 2 percent to more than 60 percent of all farm businesses each year. This helped drive the price of water entitlements and allocations upward at annual rates of growth of 12.9 percent and 25.6 percent, respectively, from 1993 to 2009 (Bjornlund and Rossini 2010). This sharp increase in market activity caught water managers by complete surprise, and neither the authorities nor the systems in place had the capacity to cope with it. There is no reason to believe that something similar could not happen in Alberta and other places in Canada. Indeed, tree ring studies suggest that Alberta and other prairie provinces are at risk of prolonged periods with significantly more scarcity than what was experienced in 2001 (Sauchyn and Skinner 2001). Hence, the Australian experience should encourage the development of institutional reforms needed to live with such scarcity at minimum socioeconomic cost without compromising water set aside to safeguard the public interest. The lesson is also that it is better to get started on policy reforms before scarcity grows and reforms become too complicated.

Solutions for Alberta

Experience from other countries suggests that many issues are associated with the introduction of water markets. How can this experience apply to the Alberta context? With the development and implementation of the province's *Water for Life* strategy, building on the foundation of the *Water Act* and, to some extent, the *Irrigation District Act,* significant progress has been made toward securing more sustainable water management and achieving the three main objects of the strategy: to secure safe secure drinking water supplies, healthy aquatic ecosystems, and reliable- quality water supplies for a sustainable economy. The recent conflict over the Balzac water transfer and the amendment of district licences to provide water for non-agricultural users – driven in part by uncertainty over securing water to safeguard public benefits – suggest, however, that the existing framework might not be the most appropriate to best serve Albertans as water scarcity intensifies.

Alberta thus should embark on a three-step reform process. The first step should secure water to safeguard the public interest, the second should improve allocation/licence structures and registers, and the third should improve existing market mechanisms, processes, and instruments.

Step 1: Secure Water to Safeguard the Public Interest

Without first properly securing protected water to safeguard the public interest, markets will not be able to operate efficiently in reallocating the resource available for consumptive use or to deliver the anticipated environmental, social, and economic benefits. It is strongly recommended that two components of protected waters be identified to secure water conservation objectives for each watershed. One is an in-stream flow component, to secure sufficient river flow to maintain healthy ecosystems that ensure adequate water quality for human consumption, recreation and, economic use while taking into account evaporation and other transmission losses. The other is an environmental events component, to secure regular environmental events such as flooding of surrounding riparian lands to facilitate germination of seeds and in other ways to support the lifecycle of flora and fauna. Once these protected waters are defined, it is possible to determine the consumptive component of water flow – the volume of water available for extractive use that the market should be able to move freely around among competing uses without compromising water conservation objectives. In an unregulated system, this component could be termed the "consumptive flow"; in a regulated system, it could be termed the "consumptive pool."

Protected waters should be defined at both the watershed and basin level as part of a planning process that reflects local hydraulic and environmental conditions, including the link between ground and surface water, local community values, and best available scientific evidence. It is imperative that such planning and the associated protected waters are defined within

an adaptive framework subject to regular review. It should be explicit that protected waters will be revised and adjusted if new scientific evidence proves that the volume of water set aside to achieve water conservation objectives needs to be adjusted. In most instances, the environment minister instructs Water Planning and Advisory Committees to identify water conservation objectives as part of the planning process; there is no reason this system could not continue. There are problems, however, with providing these groups of unpaid volunteers the financial and technical resources and processes to enable them to produce appropriate and meaningful advice.

In areas where protected waters have not yet been established, it is strongly recommended that the regional directors of Alberta Environment be instructed to set interim conservative levels of protected waters so that markets can be established and adopted by consumptive users.[5]

THE PROBLEM WITH FITFIR: The in-stream flow component of protected waters should be defined outside the licensing and FITFIR system – that is, river-flow requirements should be satisfied before licence holders are permitted to extract water – otherwise the whole concept of securing protected waters to allow the market to reallocate the balance would be compromised. If the in-stream flow component of protected waters were issued as a FITFIR licence, with the date that the water management plan defining them is approved, then on many rivers – especially in the South Saskatchewan River basin – such licences would be very junior. Hence, during periods of drought, when in-stream flow is most critical, senior consumptive licence holders would be allowed to extract water first, and little would be left in the river with which to achieve water conservation objectives. Securing in-stream flow with FITFIR licences is especially a problem in fully or overcommitted watersheds, but it would also be a problem in an adaptive regime where water conservation objectives defined today, while based on the best available science, are not final but subject to review as understanding of environmental needs within a changing climate improves. If a review in 10 years' time proves that the protected waters set aside to secure water conservation objectives must be increased, then additional waters would be secured by ever more junior and thereby marginal licences.

Alberta's *Water for Life* strategy correctly points out that increased water use efficiency is an essential component of saving water and thereby creating "new" water to meet increased demand from existing and new users. In this context, however, two issues should be considered. First, most water saved by increased efficient use results in reduced return flow, which reduces downstream river flow. Second, since licence holders have the consumptive right to the full volume of water they are allowed to extract, if they increase their water use efficiency it is up to them to decide how to use that saved water. Economically rational licence holders will either use that water to increase production or sell it to other users who will put it to consumptive use. In this case, increased water use efficiency will result in less water being returned to the river, compromising any protected water supported by junior licences. While increased water use efficiency will save water and increase productivity – one of the objectives of the *Water for Life* strategy – it will not necessarily conserve water to meet conservation objectives.[6] To continue to give existing users an incentive to increase water-use efficiency while protecting conservation objectives, the provincial government could purchase that part of the saved water that results in reduced return flow. This would ensure that water savings from efficiency gains lead to water conservation as well as increased productivity.

On the other hand, the environmental events component of protected waters could be secured by licences equivalent to those held by consumptive users and controlled by a water conservation objective custodian, which could be either a government department or, preferably, an independent body acting under a set of

5 "Conservative" is stressed since experience shows that, unless consumptive rights are granted on a share basis, they are very difficult to claw back. On the other hand, it is much easier to grant additional licences if the interim level of protected water proves too high.

6 This problem is currently the subject of extensive debate in Australia; see Crase and O'Keefe (2009).

regulations. In that way, the custodian could trade water that is not needed to secure the conservation objectives for which it was protected – for example, during periods of drought when creating environmental events such as flooding of riparian land would not be feasible and consumptive users are likely to be willing to pay relatively high prices in the allocation market. The revenue from such sales would allow the custodian to purchase even more water during periods of high flow when it becomes more feasible to trigger, say, flooding and consumptive users are likely to be willing sellers at lower prices. As long as FITFIR licences secure protected waters, the environmental events component of protected waters, when first identified, should be secured by a portfolio of licences with different priorities, making it possible for the custodian to manage the waters to achieve conservation objectives effectively.

THE CHALLENGE OFOVERCOMMITTED SOURCES AND UNUSED OR UNDERUSED LICENCES: Pivotal in balancing environmental, social, and economic uses of water is how to deal with fully and overcommitted watersheds and how to handle unused or underused licences. Where conservation objectives are secured through the planning process, it is important that all the water set aside for extractive use is used in the most efficient and productive way; hence, it would be beneficial to activate unused or underused licences to minimize negative socioeconomic effects of the process.

In overcommitted or fully committed watersheds, the effect of activating unused or underused licences differs depending on how protected waters are secured. If licences are granted under the FITFIR principle, activating previously unused or underused licences would seriously compromise conservation objectives. As more senior unused or underused licences are activated, less and less water would be available for conservation objectives during the most critical periods. Currently, in the South Saskatchewan River basin, only 55 percent of allocated water is used in an average year (AMEC Earth and Environment 2007) and in-stream flow needs are supported by the remaining 45 percent.[7]

If this water, held by more senior licences, were activated, little would be left to meet conservation objectives. If, on the other hand, protected waters were set aside outside the FITFIR system, activation of unused and underused licences would result in a less secure supply for junior licence holders, who would be increasingly cut off during droughts. Hence, under the first scenario it would be the environment that would bear the cost of activating unused or underused licences, while under the second scenario it would be junior licence holders. One way to alleviate the problem under both scenarios would be for the provincial government to enter the water market and buy out unused or underused licences or to invoke its limited powers under the *Water Act* to cancel or claw back licences.

It is imperative to deal with the issue of unused and underused licences before the value of water increases as a result of further scarcity within a closed basin and before higher water values become entrenched in the system. Before trading, such licences have little value, so that cancelling them likely would lead to less conflict and the cost of buying them out would be reduced. Activating such licences also might result in declining allocations, forcing active irrigators to buy additional water from those who have not invested in using their water, which might be considered an inequitable wealth transfer (Bjornlund 2004a).

Step 2: Improve Existing Allocation/Licence Structures and Registers

Currently, licences in Alberta are based on the FITFIR principle, to which the *Water for Life* strategy is committed. It is unlikely, however, that the FITFIR principle in its current form will continue to be the best mechanism with which to manage increasingly scarce water resources for a sustainable environment and sustainable communities (see, for example, Taylor 2009); accordingly alternative solutions are needed for the medium to long term. Standing in the way of

7 It should be noted here that Alberta has an obligation under the Master Agreement on Apportionment to allow, in general term, half the water originating in the eastern stream to flow across the border to Saskatchewan.

reform of the water licence system, however, are such obstacles as financial commitments made on the basis of current FITFIR licences and emotional attachment to the current system. The process of reform, therefore, should be inclusive and sensitive to current licence holders, with due consideration of appropriate transition arrangements and compensation.

If it were possible to introduce a new allocation mechanism on a blank slate, the most effective and robust system to manage increased scarcity would be one in which the licence holder is entitled to a share of the annual consumptive component of water as defined by a series of adaptive water management plans for each watershed. In this way, the holder would have a secure, long-term right to a certain share, while protected waters could be adjusted to take into account environmental needs, changing climatic conditions, and shifting societal values. Such a system should be combined with a risk-sharing arrangement between consumptive users and the provincial government about who should carry the cost of future changes to the consumptive pool. If the consumptive component were reduced as a result of new scientific knowledge or climate change, the consumptive users would take the risk associated with the reductions up to a certain defined threshold while the federal and provincial governments would take the risk associated with additional reductions. On the other hand, risks associated with reductions caused by changing societal values would be carried by government alone (CoAG 2004).[8] All such shares (or licences) should be of equal seniority so that, during periods of scarcity, all would share the pain equally.

That said, since a new allocation mechanism will not be introduced on a blank slate, a modified FITFIR system might be the most appropriate and cost-effective alternative. One modification could be to create two or three "bands of priority" – say, high, medium, and low security licences based on current seniority. Under such a system, all licence holders in the high security band – those with seniority prior to a certain year – would receive their water before licence holders in the medium security band. Within each band, all irrigators would be equal and would receive water according to their share. While this option is less flexible than the share system mentioned above, it would allow users to create a "portfolio" of licences that suits their risk profile. Either of these systems would ease the operation of water markets and the determination of market prices, as buyers would know more clearly what to expect when buying a water share since all would have the same priority either across all licences or within each band. After all, buyers' willingness to pay depends on the water scarcity level as well as on the security of getting access to it on a seasonal basis. During the drought of 2001, licence holders, in fact, entered into a voluntary agreement to share available water and to suspend the FITFIR rules of access – a positive outcome and one to the credit of irrigators and their leaders at the time, but not a permanent solution.

Clearly, the transition from the current FITFIR system to either of the options proposed would change fundamentally the way in which uncertainty is shared. It would also cause a high level of anxiety among current senior licence holders, so it is an objective best tackled over the medium to long term. Transition processes could include an exchange rate from the current seniority-based volumetric licences to new, share-based licences. Under such a system, what are now the most senior licences would get a larger share of the consumptive component than their current volumetric licence would suggest. Take the example of the holder of a licence to a thousand cubic meters of water in a river with a total licensed volume of one million cubic metres. This would suggest that the licence holder should have a 0.1 percent share of the consumptive pool. However, within a system with vastly different priority dates, the holder of the most senior licence on the river might get a 0.2 percent share under the new system, while the most junior licence holder might get only get 0.03 or 0.05 percent. In this way, irrigators would trade off volumes for certainty.

8 This risk sharing arrangement is currently in place in Australia under the National Water Initiative

SEPARATE WATER ACCESS FROM LAND OWNERSHIP: Currently, all water licences in Alberta are registered with Alberta Environment under the *Water Act*. These licences are associated with specific parcels of land and specific extraction points. Irrigation districts, which control 37 percent of the licensed volume in the province, hold by far the largest licences with the oldest priorities (AIPA 2002; AMEC Earth and Environment 2007). Individual irrigators are registered on district assessment rolls and have a right to water in accordance with the number of acres registered on the rolls. Further, all irrigators within a certain district have the same priority under the FITFIR principle.

Control over water access and use is linked to land. Hence, approval of the transfer of licensed water allocations is associated with an assessment of the new land to which the water use will be attached, as well as the impact of water use on that land and the change of location of the point of extraction. Irrigation transfers to purchasers outside the district require the agreement by plebiscite of the majority of district irrigators, which complicates the transfer process.

A better process would be to separate the ownership of land and water so that the transfer of water could take place without the legal complications associated with land ownership. Further, separating the ownership of the licence from the right to use the water would ease the transfer process, as it would separate the trading process from the approval of use process. Trading then would become less complicated and risks of successful transfers would be eliminated for sellers, while buyers would be able to balance the risk of subsequently obtaining the right to use the water against that of fluctuating water market prices and other factors that influence supply and demand in the market (for a more extensive discussion, see the Appendix).[9] This uncertainty would be reduced significantly if more predictable trading processes were put in place, as will be outlined in step 3. It is this separation that often causes concern over the ability of speculators and "outsiders" to buy up large volumes of water within a basin and subsequently to decide who gets the right to use it and at what price. However, if protected waters were defined and secured first and the right to use the water was separated from the right to own it, speculators could not cause environmental harm. Further, it would be worthwhile for speculators to own water only if they subsequently sold or leased it to people or companies with a use right within the zone in which the water could be used.

WATER REGISTERS AND MONITORING: Reforms will require more elaborate licence registers. If the valuable water asset were separated from the land, then it would have to be possible to register and secure the same interest in the water asset as it is currently possible to do with the land asset. This register would also have to record any additional purchases or sales of water entitlements so that the current level of entitlement associated with each licence was recorded at any given time. Accounting processes would need to be in place to ensure that the total volume of entitlements within any give water resource was kept constant. A separate set of water accounts for seasonal allocations should also be kept. These accounts should register the amount of water available for use by the account holder at any given time – that is, the volume of water yielded by a water licence or share should be credited to the account and actual use debited as it took place; similarly, the sale or purchase of water allocations during a given season should be debited or credited to the account. This function is essential to ensure that no one uses more water than they have access to.

Water use for irrigated farming in Alberta currently is not measured by a water meter but estimated based on pumping rate, area irrigated, and number of water applications. Accordingly, meters should be installed to monitor water use to ensure that water sold was not used by the seller. The introduction of meters has been considered for some time in Alberta, but its high cost has so far impeded implementation, although licensed water users in the Milk River watershed recently agreed to install them (Taylor 2009). The

9 This separation of land and water assets has a number of implications for banks, assessors, tax and stamp duty officers, councils, and property professionals, as well as licence holders; see Bjornlund (2008b).

comprehensive use of meters and rigid accounting procedures for both allocations and entitlements would give the system additional transparency and credibility – issues that will become increasingly important as scarcity intensifies and the value of water increases.

Step 3: Improve Existing Market Mechanisms, Processes, and Instruments

Once adequate protected waters to secure conservation objectives have been secured through the planning process and the consumptive pool established, water available for consumptive use should freely be traded among competing users to obtain the maximum economic output from this resource.

Experience in other jurisdictions illustrates that market activities can accelerate rapidly as scarcity increases, as water users become familiar with the operations of the market, and as allocation structures become more accommodating and barriers to trade are removed (see the Appendix). Since the current reform process and the recommendations set out above would achieve many of these outcomes, steps should be taken now to improve the market mechanisms and transfer processes so that they are able to cope with the increased activity level when needed. Experience in emerging markets for other commodities, such as electricity, suggests that the use of derivative instruments such as options and futures achieves bigger efficiency improvements than trading in the commodity itself (see, for example, ACIL Tasman 2003). How other water products can be used should also be investigated.

WATER IMPACT ASSESSMENT ISSUES: Separating the right to use water from ownership of the water licence, as noted above, should remove many of the current complexities or barriers to trade. It would separate the trade assessment from the likely impact of the new owner's water use in the new location. In the absence of such a separation, however, it would be beneficial to define a number of categories of transfers – for example, transfers with little or no potential impact requiring little or no assessment; those with some potential impact, requiring more assessment; and those with potential significant impact, requiring full assessment.

If potential traders knew which category their potential transfer belonged to, they could assess the risk associated with their trade being approved. Such classification would be further facilitated if trading zones were defined within which trading would take place with minimum or no oversight, as such transfers would have no negative impact on the environment or other extractive users. Likewise, there should be clear rules about how water could be traded between zones. Trade might be prohibited explicitly between some zones or subject to some kind of claw back between other zones to account for transmission losses or other identified impacts. This would enable potential buyers and sellers to target their search for potential partners in a transaction and inform the parties about the complications or costs associated with trading with a particular third party.

Since irrigation districts account for 71 percent of all water withdrawals for consumptive use in the South Saskatchewan River basin (Alberta 2002), irrigators, either individually or as part of a district, likely would play a vital part in providing water to meet increased demand from other sectors. It is important, therefore, that district licences be amended to create more flexibility in use. Once conservation objectives are secured, it is essential that districts be able to transfer to other users water that is not needed for irrigation and that irrigators within districts be able to make sound business decisions about whether to use their water during any given season or sell it.

IMPROVING INFORMATION FLOW, TRADING OPTIONS, AND AGENCY CAPACITY: Under current legislation, new users within closed basins could be granted a licence with no volume attached, enabling them to purchase water in the form of assignments. Some new users could choose this option as a start-up solution while they identify potential sellers and negotiate the purchase of sufficient licensed allocation. It would also make it easier for new users to enter into long-term agreements or conditional options with irrigation districts or private licence holders, who have

excess water but are unwilling to sell their licence, to purchase assignments on an ongoing basis.

The flow of market information between buyers and sellers also should be improved. There is a need for a common marketplace where buyers and sellers can post their offers to buy or sell what volume, at what price, and within which trading zone. In the first instance, this could simply be posted on a notice board on Alberta Environment's website, with a hard copy posted at the local Alberta Environment office.[10] This facility should also provide information about past sales – such as date, volume traded, price paid, and trading zone – which would allow potential buyers and sellers to identify each other, assess whether the trade was likely to be approved, and whether the price was reasonable, and could also help potential buyers and sellers to contact each other and engage in the process of offers and counteroffers.[11] Identities would be revealed if an agreement was reached, and it could then be left to the parties to conclude the deal with or without intermediaries. To ensure that such facilities and processes are put in place and adequately maintained and that transactions are processed in a timely manner, however, the human and institutional capacity of the relevant agencies would have to be augmented.

Experience in other jurisdictions – particularly the United States (see Brown et al. 1982; Gardner 1985) and Australia (see Bjornlund 2006) – suggests that such trading facilities, combined with the availability of market intermediaries such as those active in the property and stock markets, could increase market activity and generate more efficient market outcomes.

It has been argued that the use of options and futures would enhance the ability of water users to manage scarcity. Some US cities, for example, use conditional options to secure water for urban purposes during predetermined climatic conditions (Shupe, Weatherford, and Checchio 1989). Under such an arrangement, the seller receives an upfront payment to give the buyer a secure option to buy allocations during seasons in which precipitation or dam levels reach certain critical thresholds by a certain date at an agreed price. Such agreements between farmers and cities enable the latter to secure marginal demand during critical periods while the rural user retains ownership of the licence (see Byrne, Crase, and Dollery 2010). There is no reason similar arrangements should not be beneficial between other high- and low-value users such as wheat and potato growers in Alberta. The use of futures contracts would allow producers with long-term contracts to lock in the cost and availability of water relative to future commitments to deliver produce at predetermined prices.

Once the public interest needs have been agreed on, nongovernmental organizations (NGOs) could be allowed to purchase water in the market to increase the provision of public benefits to levels satisfying their needs in excess of what is provided through the planning process. In that way, minimum public benefit provisions would be made based on community values, while additional benefits could be derived through the market. The debate in Alberta so far has not favoured allowing private individuals or NGOs to hold water licences for in-stream purposes, the concern apparently being that NGOs might apply for water licences in catchments that are not closed. However, if private individuals and NGOs were only allowed to buy water licences this would not be a concern; instead, it would open up opportunities for concerned citizens to take practical steps at their own expense to secure additional public benefits while compensating sellers. This kind of market activity has been quite active in the United States (see Hadjigeorgalis 2010) and is emerging in Australia (Bennett 2008).

WATER-PRICING REGIMES: The many ways to promote a more active water market and to facilitate a more effective reallocation of water from low- to high-value users are not complete without highlighting the potential influence of

10 Perhaps an existing facility such as the "licence viewer" developed recently in the South Saskatchewan River basin could be used.

11 Alberta, like other provinces, has experience with a similar form of information dissemination through the dairy board that trades fluid and industrial milk quotas. With water trading, however, purchasers and sellers could buy from one another, rather than through a clearing house, to lower overall transaction costs.

introducing a full-cost-recovery pricing regime. In Australia, there is no doubt that the introduction of full-cost-recovery prices and water markets has encouraged many low-value producers to sell either their water entitlement or their water allocation on an ongoing basis. The double incentive of avoiding the increased cost of using the water and receiving a price for the water in the market has caused many Australian irrigators to rethink their farm business. This has been especially true during periods of extreme water scarcity and with strong demand from high-value users such as vineyards and other horticultural users as well as from the dairy sector. In essence, water pricing is the most efficient economic instrument with which to force low-value producers to sell their water. If the price is set such that producing the lowest-value crops will generate a loss, irrigators would be faced with a choice of either increasing their productivity or selling their water

Alberta, however, must consider carefully how best to implement water-pricing reform. The *Water for Life* strategy is quite explicit that economic instruments, which includes water pricing, will be used "as necessary" to achieve its objectives, but so far there has been little or no mention of water pricing, and debates about this particular instrument are likely to be heated. Moreover, the irrigation sector is largely a price taker on the international market, and could not pass on the extra cost but would have to absorb it in their budgets. Many Alberta irrigators produce relatively low-value crops, so that if a price level is set that makes it unviable for irrigators to produce they would have to sell their water. However, if high-value producers willing to buy the water are not forthcoming, or if government is not willing to purchase it for the sake of the environment, low-value users would simply have to forgo using their water. While such a solution would be efficient in the sense that it by default would provide increased flow for the environment and produce an increased security level for high-value users, it would also create financial and social hardship among the lowest-value producers and might result in an unintended large reduction in the production of lower value crops. This in turn might have flow- on effects in other industries that depend on these crops. Hence, while there is no doubt that full-cost-recovery prices would be preferable in all sectors, there are questions to which answers must be known before such a pricing regime can be implemented in Alberta's irrigation sector without unintended consequences.

Conclusions

The closure of the South Saskatchewan River basin puts the need for urgent action on water use into focus. Without an option to transfer water from old to new users, Alberta's continued economic development and its ecosystems could be threatened. It is also a reminder for other basins, such as those that depend on water for use in resource extraction processes, that it is time to implement reforms capable of dealing with increasing scarcity. Any solutions, however, should be sufficiently robust to apply to all basins and be capable of handling whatever the future might bring in terms of climate change, changing community values, and economic pressures.

The most urgent action should be to define and secure protected waters to support water conservation objectives. Two types of water protection are needed to meet in-stream needs and to create environmental events to ensure the continued health of the riverine environment. Since the in-stream component would be best secured outside the licensing system, these minimum flows should be secured before extractive use is permitted; alternatively, the provincial government could purchase senior licences to secure this water. The environmental events component should be secured by a portfolio of FITFIR licences of different priorities to enable the custodian of these licences to manage environmental events effectively. With such a system in place, the consumptive component of water could be defined, and a relatively free market would move this water around efficiently among competing users to maximize the economic benefit and reduce the socioeconomic impact of securing protected waters.

In this context, the first issue that should be addressed is that of unused and underused licences. As scarcity increases, markets become more widely adopted, and water entitlements and allocations gain value, more and more unused water will be activated. Within a fully committed basin, increased activation would come at a cost either to the environment or to junior extractive licence holders, depending on how the protected waters were secured. If the in-stream flow component were secured outside the licensing system, the cost would be borne by junior licence holders – as unused senior licences are activated, some junior licences would be cut off. If protected waters were secured by new junior licences, then the needs of the environment might not be met.

Second, steps should be taken to facilitate the efficient operation of markets. For instance, a tier of transfers should be established, each requiring different levels of assessment, as well as trading zones within which little or no assessment is needed and clear rules about how trading can take place between them. These measures could be implemented immediately, allowing buyers and sellers to enter into transfers more confident of the outcome. In a similar vein, the flow of information about supply, demand, prices, and past transactions should be easily accessible so that buyers and sellers can identify each other and establish the current price. This could be done, in the first instance, through some kind of "bulletin board" managed by Alberta Environment.

Third, land and water should be separated into different assets on which transactions and legal instruments can be registered and secured. The right to use the water should be separated from ownership of the licence so that ownership can change without the need for any assessment. As well, alternatives to the current FITFIR system should be considered, since it is unlikely the best mechanism with which to manage increasingly scarce water resources for a sustainable environment and communities. Moreover, since the pain of the transition to any new system might not be shared equally among users, any reforms in that direction should considered carefully for their financial impact on existing licence holders.

Finally, it is imperative that Canadians understand and accept that the problem of water management is one that they have created collectively through the introduction by elected officials of policies and economic incentives to increase water use in pursuit of what has been perceived as in the public interest. If the best public outcome no longer can be achieved by continuing past practices, new policies must be devised to achieve that result, and taxpayers will have to be prepared to share the burden of changing outmoded practices just as they shared the benefits in the past.

Appendix A The Challenges and Limitations of Water Markets

Given the strong economic and political rationales for water markets, why have so few markets emerged around the world? Indeed, in only a few places – among them Australia, the United States, Chile, South Africa, and Alberta – have water markets been formally introduced. In some developing countries, such as India and Pakistan, informal and, in many instances, illegal markets in temporary access to water have been active, while in other countries, such as Spain and Oman, variations of water trading have been in use for a long time (see Maas and Anderson 1978; Al-Marshudi 2007).

Capacity Challenges: The Need for Complex Institutional and Governance Structures

One reason markets have not been widely introduced relates to the complexity of the systems and institutions that are required for markets to function efficiently, which need extensive human and financial capital that is absent in many developing countries. In Chile, for example, there is a multitude of registers, and many entitlements are not registered, which leads to legal uncertainty about ownership (see Bjornlund and McKay 2002).

As in Alberta, traders in jurisdictions such as Australia and Chile find the transfer process cumbersome due, for example, to the need to produce irrigation and drainage management plans, to prove their use of best-management practices, and the need to advertise – all of which is costly both in time and money and with uncertain outcomes (see Tural et al. 2005). In southeastern Australia, however, as restrictions on trading eased and scarcity intensified, trading activities increased. When drought intensified in 1997, the number of transfers increased significantly, forcing authorities to introduce automated transfer processing to cope with the increased volume (Bjornlund 2003a). This development saw the emergence of a large number of brokers and private water exchanges, improving the availability of market intermediaries and access to real-time information about supply and demand in the market. This put a trading platform in place that since 2002 has coped with and facilitated an explosion in market activities (Bjornlund 2008c). In Chile, high transaction costs and unpredictable market outcomes caused by costly judicial procedures, often taking years to conclude, have been identified as major impediments to water trade (Bauer 1997; Brisco, Salas, and PeZa 1998), as have confusing and multiple registers or water rights and inflexible supply systems (Hadjigeorgalis and Lillywhite 2004).

Since a new water policy framework was put in place in Australia in 1994 (CoAG 1994), water policy and management has been on a long and increasingly urgent reform journey. Land and water rights have been separated so that water entitlements can be traded more easily, trading zones have been established with clear rules about how water can be traded between them, and water planning processes have been made mandatory for all watersheds in order to establish the total volume of water available and to identify environmental needs – and thereby to determine how much water can be extracted sustainably and shared among extractive users (the consumptive pool).

In Australia it was also argued that the water entitlement should be unbundled into its components to improve water users' ability to manage their access to water and the risk associated with its availability and delivery within a planning framework that defines the consumptive pool as the volume of water left once environmental needs have been met (see Bjornlund 2000, 2004b; Young and McColl 2002, 2003). With the National Water Initiative (CoAG 2004) and associated reforms at the state level, most of these proposed changes have been implemented. Water entitlements have been unbundled into:

- a water access entitlement, a document ensuring the holder of the right access to a share of the available consumptive pool each year;
- a water allocation, the volume of water that the allocation holder can extract from the resource for consumptive purposes during a given season; this water can be derived either as the yield from a water access entitlement owned by the allocation holder or through purchases in the allocation market;

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- a water use right, the right to put a water allocation to consumptive use, which is site and purpose specific; to obtain it, the user must prove responsible water use with no adverse environmental impact; and
- a capacity share, which guarantees the holder access to a defined share of the supply capacity of the system delivering the water to the user.

As a consequence of these changes, trading in both entitlements and allocations now takes place without any assessment of the impact of the buyer's use of the water, since the purchase of the water includes no right to use it or get it supplied. To use the water, the buyer must have the appropriate use right, must have a supply capacity share, and must be located in a zone to which the water can be traded. Obtaining the use right is a separate process and does not delay transfers. It is up to buyers to ensure that they have the appropriate use right and supply capacity share or to take the chance that such right will be obtained subsequent to the purchase.

Australian jurisdictions currently are introducing water registers to manage water entitlements, register trades, and secure the integrity of the transfer process and ownership of the entitlements and legal interests such as liens, mortgages, and encumbrances registered against the entitlement. Similarly, water allocation accounts have been introduced to record seasonal access to and use of water. For instance, when the allocation is announced at the beginning of the season as a percentage of the entitlement, the available volume of water yielded by a given entitlement is credited to the entitlement holders' allocation account; as the allocation is revised during the season, any additional water yielded by the entitlement is also credited to the account. If the entitlement holder sells or buys allocation during the season, these volumes are also debited or credited to the account. A person without a water entitlement can also hold an allocation account and get water bought in the allocation market credited to the account. Each quarter, water use is debited to the account according to meter readings. Such registers are essential in controlling ownership, and a consistent debit and credit system ensures that the total volume of water entitlements stays constant and that extraction stays within the consumptive pool, thereby safeguarding the integrity of the system.

Community and Social Concerns

A second set of reasons water markets have been slow to develop relates to the perception of water as a social good, one not subject to market forces, and to the potential impact of trade on affected farmers and their communities. A rational analyst might argue that much of this impact will occur regardless of water trading as a result of inevitable and ongoing structural adjustment in response to changing economic, political, and climatic conditions. Nevertheless, experience in Australia, the United States, and Chile is unanimous that this perception might be the main reason for the low level of adoption of water trading. In Australia, there are examples of sellers being frozen out of their communities because selling water is perceived as treason and as selling out the community (Fenton 2007). Experience with both the Balsaz transfer and the dispute over the amendment of irrigation district licences highlights the controversial nature of this issue in Alberta as well.

Australian research provides some insight into how irrigators and their communities see these social concerns. A 1998-99 survey of buyers and sellers in the allocation market and of irrigators who had never traded revealed that more than 80 percent of those trading, but only 48 percent of those who had never traded, agreed that water trading was a good idea. More than 60 percent said that they agreed with allocation trading, since the water right stays with the seller, while a similar percentage agreed that entitlement trading was needed to justify long-term investment (Bjornlund 2005). A 2003-06 survey of traders indicated that considerable concern over water trading still existed, with more than 80 percent agreeing with statements related to the negative impact of

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trading (Bjornlund 2008a). One main concern was associated with the impact both on individual farmers and on their communities of trading out of districts. Another concern related to the concentration of water in fewer hands and the emergence of more corporate farming and speculative market behaviour.[12]

Australian surveys have also revealed that irrigators not selling their water were concerned about stranded assets and the associated increase in cost to them of large volumes of water being traded out of their supply system. Since irrigators pay the full cost of water and most costs are fixed, a reduced volume of supply would result in increased cost per unit delivered. There was also a concern that eventually it would be unviable to keep certain channels open and that remaining farmers would be unable to irrigate, thus suffering substantial capital losses. In the state of Victoria, which acknowledges both of these impacts, water charges have been divided into two parts to accommodate the first concern. The first part covers the fixed cost of the system and the second the variable costs associated with managing the system. The charge covering the fixed cost is charged against the supply capacity share and remains with the seller if the water is sold to outside the system. Hence the sellers are obligated to continue to pay their share of the maintenance of the system. Regarding the second concern, the state government has promised to compensate farmers for the lost property value associated with losing the ability to irrigate (Victoria 2004).

Another concern is that, as farmers sell their water, many farms are left uncultivated. In many instances, speculators have purchased properties, sold the water, and simply left most of the buildings and land unattended, which then become a haven for weeds and pests and a nuisance to neighbouring farmers.[13]

Community members are also concerned that the sale of a large proportion of a region's water will result in community decline. A transition from irrigated to dry land farming or to no farming at all would result in decreasing farm revenues, job losses, and declining business for local providers of farm input and services, leading to declining population and reduced demand for local businesses and services, schools, child care, and doctors. Community members are also concerned that, as irrigated land is converted to dry land, its value will decline, thus reducing the tax base. Thus, either property taxes must increase for all properties or the community's revenue will decline, eroding services such as local roads and libraries. These developments potentially reduce community viability and the ability to retain the local culture as the pillars that support the community disappear.[14]

The increased use of markets and the associated separation of land and water rights also give speculators and corporate farms an opportunity to enter the market. In Australia, there is widespread fear in irrigation communities that this will occur, with water ultimately ending up in the control of people without any affiliation with the local community and the emergence of "water barons"

12 A series of 32 focus groups with farmers in 2003 discussed these concerns in more detail; see Bjornlund (2003b).

13 For the Australian experience with this problem, see Edwards, Bjornlund, and Cheers (2007); and Fenton (2007). Similar outcomes have been reported in parts of the United States; see Colby (1988); and Young and Taylor (1990).

14 Both Edwards, Bjornlund, and Cheers (2007) and Fenton (2007) report the emergence of these impacts in Australia, but do not differentiate evidence of a causal relationship between community decline and water trading, on the one hand, and the impact of severe drought, on the other. Such concerns have also been reported in the United States, where, in the early years of water markets, urban centres in the southwest purchased huge volumes of irrigation water from some communities (see Mumme and Ingram 1985; Checchio and Colby 1988; DuMars and Minnis 1989; and Gilliand, Wallin, and Smaus 1989), and in Chile (Romano and Leporati 2002). Possibly the most extreme example of this comes from California, where, during the 1920s and 1930s, Los Angeles purchased all the water in the Owens Valley, resulting in a 20 percent population drop in that region, the closure of six schools, and a 50 percent drop in sales by local businesses. Claims against the city for loss of jobs and business were settled when Los Angeles purchased most of the buildings and agricultural land in the valley (Nun and Ingram 1988).

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who control the supply of water and set prices (Bjornlund 2003b).[15] The Victorian government's response has been to limit the proportion of the consumptive pool that any given person or entity can own within a system.

Public Interest Concerns

Public interest concerns relate to securing water for public benefits – primarily to secure adequate in-stream flows to support healthy ecosystems and key environmental assets by enabling the creation of environmental events such as floods. Public benefits can also include social and community needs or water for recreational and cultural purposes. What is considered to be an adequate supply of water for public benefits should be defined in accordance with local community values, supported by the best available science. The market, however, is unlikely to supply adequate water to ensure that public benefits are obtained, since it operates between individuals who seek to maximize their own benefits.

In the United States, NGOs have made extensive use of the market to secure water for public benefits (Hadjigeogalis 2010). In most jurisdictions, however, this is not likely to be the case, as the population base and the financial capacity of the population might not give NGOs the means to purchase sufficient water. Perhaps more important, there is no certainty that the public benefit values of these NGOs reflect those of the wider community or that the sum of such purchases will be enough to satisfy public demand. In Australia, planning processes are defining the public benefit needs on a watershed basis. Licences are not issued for the water needed to secure these objectives; instead, water is set aside before the consumptive pool is established. In other words, the public benefit water is secured first and entitlement holders get access to what is left.[16]

The issue of securing water to provide public benefits is of utmost importance for the community acceptance of water markets and for their efficient operation, since only within such a system can water trading take place without complex processes.

Get Started before Reform Becomes Too Complicated and Expensive

In most societies, there has been a tendency to postpone major water reforms. From a political perspective, this is often preferable, as significant reform of water management is associated with a high level of conflict among competing users, emotional community debates, and significant community pain. Further, individual users have long-standing rights to these resources, which, in many cases, are associated with significant capital investments. Changing the way people are able to use and access such rights, therefore, can have serious consequences. Experience from around the world suggests, however, that it is actually a lot easier and cheaper in economic, social, and political terms to introduce reforms before scarcity intensifies conflicts over access and use.

For water markets to work water must be scarce; if users simply can apply for a licence to use water and get it for free, a market has limited useful purpose. When a basin is closed for new licences, as happened in South Australia in the early 1980s and in Alberta in 2006, a market is needed as a mechanism for new users to access water. But as long as existing licence holders have access to use

15 In the horticultural regions, in particular, there are fears about the impact of corporate farming, as these operations buy up large volumes of water for industrial-sized plantations of vines, citrus, almonds, olives, and other plantings, to the detriment of family farms, which traditionally have been the backbone of this industry (Edwards, Bjornlund, and Cheers 2008; Kuehne, Bjornlund, and Loch 2009). The major instigator of this development, however, has been tax incentives, rather than the introduction of water trading.

16 In the current severe drought, however, consumptive users are allowed to access public benefit water and, as a tool to secure environmental water, the planning process has disintegrated to reduce the social pain. In response, the Federal Government in Australian as well as state governments, the Murray Darling Basin Association, and various semi-public organizations increasingly are relying on water markets to purchase water from willing sellers to secure environmental outcomes (Connell and Grafton 2008; Loch, Bjornlund, and Kuehne, 2010). This illustrates that the processes set in place in Australia were not sufficiently robust to deal with the levels of scarcity experienced.

Appendix A *(Cont'd)*

more water than they need, a market is not likely to be very active since it is mainly new users who will need to resort to it. If water becomes scarce, however, the consumptive pool will be reduced and market activities will increase.

In Australia, increased scarcity resulted in a sharp increase in transfer applications over just a few years, for which the authorities were totally unprepared, resulting in long transfer processes that undermined the smooth functioning of the market (Bjornlund 2003a). Electronic water exchanges and transfer processes were introduced to handle the increased volume. As a result of increased scarcity, improved transfer processes, an easing of trading restrictions, and increased irrigator familiarity with the process, market participation increased from a few percent of farm businesses trading each year to more than 60 percent by 2004 (Bjornlund 2006). Similarly, water purchased in the allocation market accounted for an increasing proportion of total water use, increasing from only 3 to 5 percent of water use in the mid-1990s to more than one-third by 2008 (Bjornlund and Rossini, 2010). While it could be argued that the entitlement market in Australia still has a limited influence on who owns water entitlements, the allocation market now has a significant influence on who uses water each year. So, when scarcity intensifies and as irrigators become familiar with the use of water markets, acivities in these markets can increase quickly.

Glossary of Terms

Allocation market: A generic term used in this paper to represent all markets in which the short-term right to use a certain volume of the seasonal allocation of water is traded, while the seller continues to own the long-term entitlement. This market is sometimes called the "temporary market," the "short-term market," the "spot market," or, in Alberta "assignments."

Assignments: Under the *Water Act* an assignment is the transfer of the right to use a volume of water during a given season from one licence holder to another.

Consumptive flow: The flow of an unregulated river in excess of the protected waters, that is the flow that can be extracted for consumptive use without compromising the public interest as defined in the water management plan.

Consumptive pool: The pool of water available within a regulated river system that is in excess of the protected waters. Thist is the pool of water that can be extracted from the system without compromising the public interest as defined in the water management plan.

Entitlement market: A generic term used in this paper to represent all markets in which the long-term entitlements to receive water allocation each season are traded. This has often been termed the "permanent market," the "water rights market," or, in Alberta, the "market for licensed water allocations."

Environmental events component: A sufficient volume of water set aside as part of the protected water to secure regular environmental events such as flooding of surrounding riparian lands to facilitate germination of seeds and in other ways to support the lifecycle of flora and fauna.

In-stream flow component: A sufficient volume of water set aside as part of the protected waters to secure sufficient river flow to maintain healthy ecosystems that ensure adequate water quality for human consumption, recreation and economic use while taking into account evaporation and other transmission losses.

Protected waters: Water set aside as part of a water management plan to secure water conservation objectives and consisting of an in-stream component and an environmental events component.

Water allocations: The volume of water that the licence holder has the right to extract from the river and under the *Water Act* includes the "volume, rate and timing of a diversion of water."

Water allocation transfer: Occurs when existing licence holders sell all or part of their licensed allocation to another person or organization. When this happen the traded allocation is separated from the seller's land and a new licence is created and the water attached to the buyers land with the same seniority as the seller. Such transfers have to be approved by Alberta Environment. Conditions can be placed on the transfers and up to 10 percent of the allocation can be withheld by the Director to implement water conservation objectives. Transfers can only take place as authorized by an approved water management plan.

Water conservation objectives: are defined under the Water Act as the amount and quality of water necessary to protect the aquatic environment as well as recreational, tourism, transportation, and waste assimilation uses of water. In the context of this paper this can also include water set aside to meet cultural or social needs as defined within a water management plan.

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