PARRYING WATER CONFLICTS IN THE OKANAGAN:

The Potential of a Water Market

Johannus Anthonius Janmaat*

In 2008, the BC government released its "Living Water Smart" strategy.[1] This was described as a wide-ranging effort to bring together and harmonize current, widely dispersed responsibilities related to water management. The strategy promised a range of actions to improve water management in British Columbia, one of which was to review and to revise the provincial Water Act.[2] In 2009, an extensive consultation process began to identify concerns with the current act and to suggest ways of improving it. A discussion paper released early in 2010 sets out the key objectives of this reform and notes that its scope is limited to the Water Act's functions, policies, and decision-making processes.[3] The goals are: to protect stream health and aquatic environments, to improve water governance arrangements, to introduce more flexibility and efficiency in the water allocation system, and to regulate groundwater extraction and use in priority areas and for large withdrawals.

These goals are not particularly contentious, but achieving them will not be easy. Protecting stream health and aquatic environments means that environmental demands must sometimes trump other demands. Improving water governance arrangements implies giving voice and power to those interests that currently have little of either. Introducing

* I am grateful to Kasondra White, the graduate student and research assistant who conducted all the interviews. I would also like to thank Graeme Wynn and two anonymous reviewers from *BC Studies* for their insightful and challenging comments, all of which helped to improve this article. Any remaining errors or oversights are solely my responsibility.

1 British Columbia Ministry of Environment, *Living Water Smart: British Columbia's Water Plan*, 2008, available at http://www.livingwatersmart.ca/docs/livingwatersmart_book.pdf (accessed April 2010).

2 British Columbia, Legislative Assembly, *Water Act*, 1996, available at http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_96483_01(accessed December 2010).

3 British Columbia Ministry of Environment, *British Columbia's Water Act Modernization: Discussion Paper*, 2010, available at http://www.livingwatersmart.ca/water-act/docs/ wam_discussion_paper.pdf, 2 (accessed April 2010).

more flexibility and efficiency into the water allocation system likely means that some current users will have less water so that new users and new uses can be accommodated. And regulation of groundwater extraction will limit who can gain access to groundwater and how much they can take, at least in priority areas. Unless the reform process is merely a public relations exercise, it will seriously affect some stakeholders.

This analysis focuses on the possibilities for introducing more flexibility and efficiency into the water allocation system, with particular attention on the Okanagan, where this is a critical issue. Using data available through the BC Ministry of the Environment's Water Stewardship Division,[4] several aspects of the water "crisis" in the Okanagan can be highlighted. Among the 3,423 water sources in the Okanagan that have at least one current water licence that specifies a water volume, 3,064, or 89.5 percent, are subject to restrictions on issuing new licences.[5] Almost two-thirds (62.6 percent) of the almost 642 million cubic metres of currently licenced extraction comes from these restricted water sources. On many streams, licenced volumes exceed the normal annual discharge. Water continues to flow because actual withdrawals are far below licenced quantities and because return flows replenish streams. In a serious drought, however, utilization may increase at the same time as water availability falls. A serious drought did occur in 2003, which led the Department of Fisheries and Oceans (DFO) to order a release of water to protect fish in Trout Creek, an important tributary stream near the town of Summerland.[6] The DFO action forced water users supplied by the District of Summerland to quickly develop a plan to allocate the suddenly much smaller available water supply. While this response was restricted to the Trout Creek watershed, the drought was felt throughout the valley. The dry conditions also contributed to the Okanagan Mountain fire of that year.[7] The forecast impacts of climate

---

[4] British Columbia Ministry of Environment, Water Stewardship Division, "Water Licences Query," available at http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input (accessed April 2010).

[5] Some units of measure (e.g., horsepower) cannot easily be translated into a measure of volume.

[6] C. David Sellars and Rod Smith, "Application of the Water Use Plan Approach to Resolve Water Management Issues on Trout Creek in Summerland." In *Proceedings of the CWRA Kelowna Conference: Water – Our Limiting Resource* (Kelowna: Canadian Water Resources Association, 2005).

[7] Protection Branch, BC Ministry of Forests, *Fire Review Summary for Okanagan Mountain Fire (K50628)*, available at http://bcwildfire.ca/History/ReportsandReviews/2003/Okanagan_Fire_Review_K50628.pdf (viewed September 2010).

change are likely to increase water demand, while adversely affecting water availability, thereby increasing the risk of drought.[8]

This article presents the results of a simple modelling exercise in order to illustrate one way that the current water licencing system may govern water distribution during a serious drought, together with some data from an irrigator survey which suggests that water can be better utilized if it can be moved between water irrigators and that some of these irrigators may be open to using a market to move water. In the interest of brevity, debates about whether water should be considered a commodity or some sort of common good, and whether access to water is a fundamental human right, are not discussed, although they may well have to be addressed before a water market is established. Water is a complex "fluid" substance, and implementing an effective system that relies on individual choice is not a trivial exercise, whether that system uses freely chosen trades between individual rights holders, more accurate water prices, or some appeal to community and common values. Using a water market to reallocate some of the water supply among a set of water users is not a substitute for watershed planning, managing instream flows, and so on;[9] rather, it is a tool for reallocating water, a tool that can be used both to maximize the value society receives from water that is consumed and to redirect water to purposes such as protecting valuable environmental resources.[10]

In order to clarify the discussion, it is necessary to understand how economists define "efficiency." To economists, efficiency occurs when the difference between all benefits and all costs is maximized. These

---

8 Ted van der Gulik, Denise Neilsen, and Ron Fretwell, *Agricultural Water Demand Model: Report for the Okanagan Basin* (Kelowna: Okanagan Basin Water Board, 2010).

9 See Henning Bjornlund, *The Competition for Water: Striking a Balance among Social, Environmental and Economic Needs* (Toronto: C.D. Howe Institute, 2010); and Cesare Dosi and K. William Easter, "Market Failure and Role of Markets and Privatization in Alleviating Water Scarcity," *International Journal of Public Administration* 26, 3 (2003): 265-90, for a more detailed description of the issues that must be taken into account in order to implement a water market while protecting other concerns.

10 "There is a growing realization that water management provides a bundle of services that can be divided up, with some of the services better (more efficiently) provided by the private sector (Easter and Feder, 1997). By unbundling services, the public sector can maintain its role where it is most important, i.e., protect against monopoly power, negative externalities, the under-provision of public goods, and the overuse of open access water. The private sector and market forces can then be used to help better manage and allocate water services." C. Dosi and K.W. Easter "Water Scarcity: Institutional Change, Water Markets, and Privatization" in *Economic Studies on Food, Agriculture, and the Environment*, ed. M. Canavari, P. Caggiati and K.W. Easter (Boston: Kluwer Academic Publishers, 2002), 94 and see also K. William Easter and G. Feder, "Water Institutions, Incentives, and Markets," in *Decentralization and Coordination of Water Resource Management*, ed. D.D. Parker and Y. Tsur, (Boston: Kluwer Academic Publishers, 1997), 261-82.

benefits and costs include all external and non-monetary benefits and costs as well those that are monetary. Thus, the value of protecting instream flows goes beyond the value of any extra fish caught to include the enjoyment of recreationalists and the pure existence value that people place on a slightly healthier habitat, much of which cannot be easily measured in any market. Unless otherwise stated, references to a "best" use or outcome assume that all these impacts are considered. Similarly, references to value are to be taken to be consistent with how benefits and costs have just been defined. Further, the "right price" for water is the price that leads to its economically efficient use. Thus, this price accounts for those things that water provides that cannot be bought or sold and that would lead water users to use the "right" amount of water.

WATER RIGHTS IN BRITISH COLUMBIA

Water in British Columbia belongs to the Crown. Users have usufructuary rights, defined through the issuance of a licence, which conveys a right to use a quantity of water for a specific purpose at a specific location within a particular period of time. The principal role of the Water Act is to define a process for distributing these usufructuary rights, detailing the nature and features of these rights, and defining a process for arbitrating conflicts between rights holders. Key features of BC water rights are: (1) each water licence is appurtenant to a parcel of land; (2) transfers of appurtenancy require agreement of the parties involved and of the relevant water controller, who is responsible for ensuring that other parties are not adversely affected; (3) licence holders must use the water described in their licence or risk having their licence cancelled ("beneficial use," or, more accurately perhaps, "use it or lose it"); and (4) all licences have a priority date, which determines the order in which they are cut off should there be insufficient water to supply all of them ("first in time, first in right," or FITFIR). The FITFIR and beneficial use aspects of this rights system first appeared in the arid southwestern United States as a way of ensuring security of access to water to those searching for gold.[11] A miner's claim would have little value if that miner could not secure the water necessary to exploit the claim. First the Canadian federal government, and then the provinces, borrowed heavily from the American experience in drafting Canadian water law. In arid areas, farmers are in a similar situation, where large

[11] Joseph W. Dellapenna, "United States: The Allocation of Surface Waters," in *The Evolution of the Law and Politics of Water*, ed. Joseph W. Dellapenna and Joyeeta Gupta (New York: Springer, 2009), 189–204.

investments in farm infrastructure will often pay off only if there is secure access to water. Thus, FITFIR ensures security and facilitates investment.

In early days, water users typically applied for licence volumes that were much larger than the amount they would use. Once their diversion works were constructed, the government water manager generally revised the licence downward to be consistent with the capacity of the constructed works and the volume of water that could be put to beneficial use. There was no provision for the ecosystem services provided by natural water flows, with the result that licenced withdrawals on many streams exceed normal flows. Fortunately for both ecological requirements and the interests of junior water licensees, most licence holders do not use anywhere near the amount that their licence entitles them to use.[12] Thus, Okanagan streams have seldom run dry, and junior water licensees have rarely been cut off. In recent years, however, the provincial government has marked most streams in the valley as restricted, so that no additional licences are permitted along their courses.

This would not be such an issue were it not that people continue to move to the Okanagan and that climate change threatens to increase water demands, while changing the mix and timing of precipitation.[13] With little practical capacity to increase supply, new demands will have to be satisfied by moving water out of existing uses. American legal scholars Shupe, Weatherford, and Checchio note that water resource management in western North America has moved to an "era of reallocation,"[14] and environmental historians Armstrong, Evenden and Nelles detail a similar story with respect to irrigation along the Bow River in Alberta.[15] The challenge is to find a mechanism for reallocating water that both improves water governance and enhances efficiency. There is much discussion of the merits, and failings, of different water allocation systems, but most of these debates have revolved around some ideal such as economic efficiency, participation, or equitable treatment. Seldom have the implications of serious water scarcity been examined.

---

12 The fact that licence volumes are excess to use suggests that the water manager who accepted the final licence size left considerable slack. It is unclear why this was done. However, its persistence is a consequence of the fact that application of the beneficial use criterion to reduce or retire licences is generally complaint driven, and, historically, there have been few instances when it has been worthwhile for junior water users or prospective water users to pursue this matter in court.

13 Stewart Cohen and T. Kulkarni, *Water Management and Climate Change in the Okanagan Basin* (Vancouver: Environment Canada and University of British Columbia, 2001).

14 Steven J. Shupe, Gary D. Weatherford, and Elizabeth Checchio, "Western Water Rights: The Era of Reallocation," *Natural Resources Journal* 29, 2 (1989): 413–34.

15 Christopher Armstrong, Matthew Evenden, and H.V. Nelles, *The River Returns: An Environmental History of the Bow* (Montreal and Kingston: McGill-Queen's University Press, 2009).

To explore the implications of licence hierarchy in the Okanagan a hydrologically connected model of the one hundred tributaries with the largest consumptive use licenced volumes, together with necessary connecting streams, was built using Java™. Excepting the Okanagan River south of the border with the United States, each stream in the network was a tributary to one higher-level stream and could have any number of tributary streams flowing into it. For simplicity, each stream was treated as a pool of water, and geographic details pertaining to points of diversion and locations where tributaries discharge into main streams were ignored. Figure 1 shows the hierarchical network for the Mission Creek watershed, as represented in the model, while Figure 2 shows a map of the Mission Creek watershed. Notice that Belgo Creek is not included as there are few consumptive licences on that creek.

The distribution of water under different levels of scarcity was evaluated by first fixing the level of water available in each tributary and then determining which licences in the watershed ending at Osoyoos Lake would receive water. For the latter stage, all licences in the watershed that were for a "consumption purpose," as defined by the Water Act regulations, were ordered from oldest to youngest and then added in sequence to the model system. Each added licence was allocated as much water as possible, up to that volume that would fill the entire entitlement or that would result in a more senior licence somewhere downstream receiving less. For the results presented below, the cases examined start with each stream having an inflow equal to 100 percent of the volume licenced on the stream, equally reducing that percentage over all of the connected streams.

FIGURE 1
Mission Creek tributary watershed, as represented in the hierarchical model. Each stream and tributary is treated as a pool, with water flowing into a pool further down in the watershed.

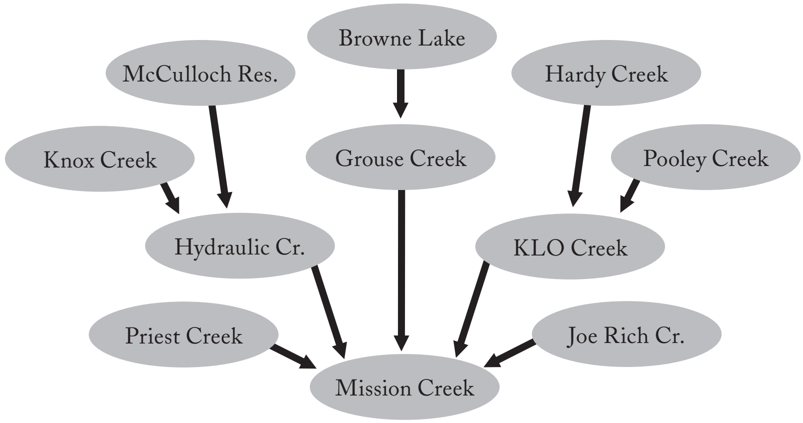
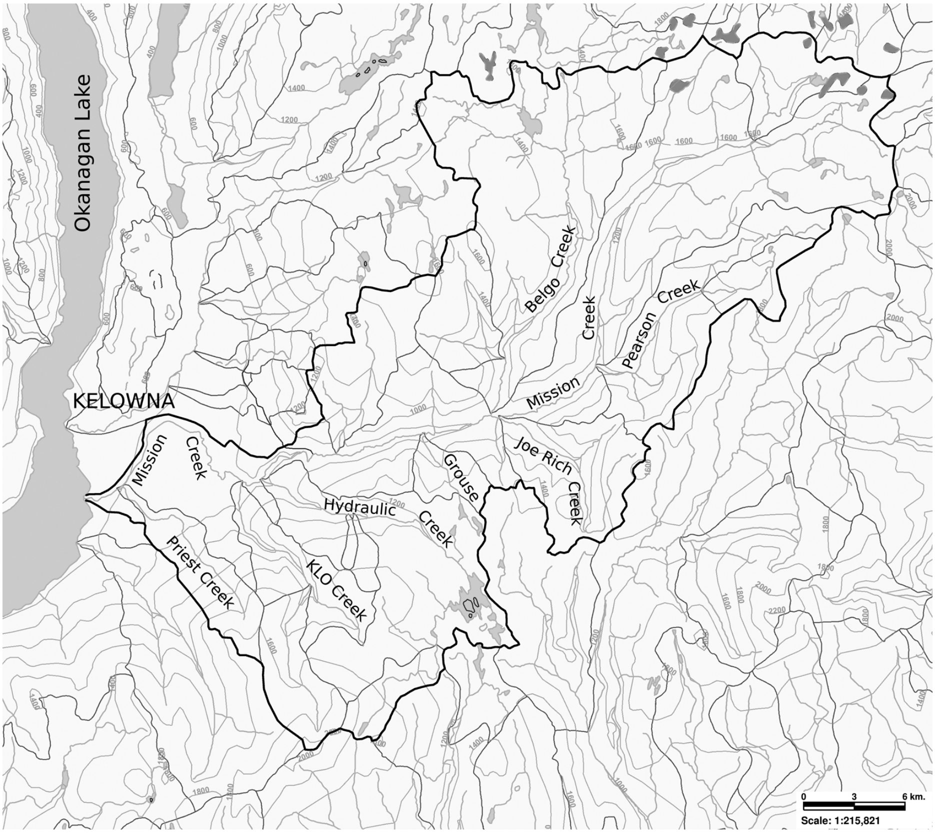


FIGURE 2
Mission Creek watershed, with major tributaries



Source: Government of British Columbia Integrated Land Management Bureau, iMapBC http://webmaps.gov.bc.ca/imfx/imf.jsp?site=imapbc (viewed August 2010).

To illustrate, consider the hypothetical example summarized in Table 1. Suppose that Belgo Creek has two licences, a 100 acre feet (af) waterworks licence with a priority date of 1950 and a 200 af irrigation licence with a priority date of 1930, and that Mission Creek, into which Belgo Creek flows, also has two licences, a 150 af waterworks licence with a 1970 priority and a 250 af irrigation licence with a priority date of 1910.[16] For the model, inflows into Belgo Creek equal 300 af and inflows into Mission Creek equal 700 af before any withdrawals and in the absence of water scarcity. Each licensee is then able to withdraw her

[16] An acre foot is enough water to cover an acre of land to a depth of one foot, or 1,233.48 cubic metres. Most large licences in the Okanagan are denoted in acre feet.

or his full licence entitlement. If inflows are 0.50 down for the system, then inflows into Belgo Creek equal 150 af and those into Mission Creek equal 350 af before withdrawals. The most senior licence in the system can take 250 af, which is 200 af of Mission Creek inflow, 50 af of which flows into Mission Creek from Belgo Creek. The next most senior licence in the system is the senior licence on Belgo Creek. It is able to take 100 af, which is the balance of the water available in Belgo Creek. It cannot take the other 50 af as that would prevent the senior licence on Mission Creek from taking its full entitlement. The remaining two licences do not get any water. Thus, for this hypothetical example, a 50 percent reduction in available water in the system leads to a 22 percent reduction in irrigation water, a 100 percent reduction in waterworks water, a 38 percent reduction in water withdrawals from Mission Creek, and a 67 percent reduction in withdrawals from Belgo Creek.

TABLE 1
*Hypothetical pattern of licences on Mission and Belgo creeks, and impact of two different water reductions**

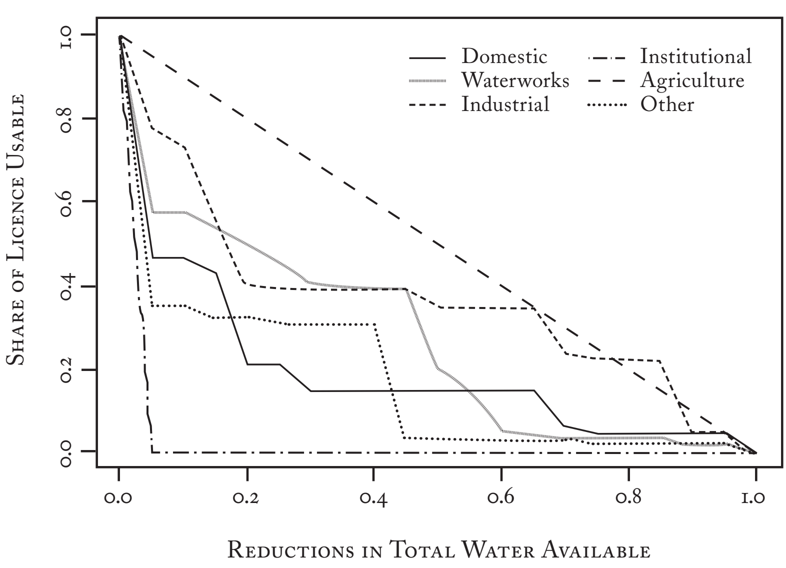
				1.00 OF LICENCES		0.50 OF LICENCES		0.75 OF LICENCES	
Source	Volume	Priority	Purpose	Inflow	Used	Inflow	Used	Inflow	Used
Mission	250	1910	Irr.	700	250	350	250	525	250
Mission	150	1970	WW	250	150	0	0	50	50
Belgo	200	1930	Irr.	300	200	150	100	225	200
Belgo	100	1950	WW	100	100	0	0	25	25

* Purposes are agriculture (Irr. for irrigation) and waterworks (WW). Inflows are water available before any is withdrawn (Used), cumulative of new inflows and inflows from tributaries. Reductions are relative to enough inflow to satisfy all licences on each stream.

Continuing with the example, consider water available equal to 0.75 of the total to satisfy all licences. In this situation, inflow before withdrawals is 525 af in Mission Creek and 225 af in Belgo Creek. There is now enough water in each creek for the most senior water users to withdraw their entire entitlement. Of the two remaining licences, the one upstream on Belgo Creek is senior to the one on Mission Creek. However, because it is upstream, this licensee is only able to withdraw the remaining 25 af in Belgo Creek. The most junior licensee, located on Mission Creek, is able to withdraw 50 af, thanks to the fact that this licensee is downstream of the more senior user. This illustrates that, if the senior licensee is upstream, seniority on its own may not offer much protection in a drought.

Two important consequences of the existing system are the implicit priorities afforded uses and licensees. Figure 3 shows the share of the total licence volume for each general purpose category that can be used, for a range of reduced recharge levels. A use that is relatively junior will see its share fall faster than the reduction in available water, shown as a line that lies below a diagonal. The converse is true for relatively senior uses. Agricultural licences are typically the most senior and represent by far the largest share of the total licence volume. This disproportionately large share of the total licence volume is one reason why it is almost impossible to see that, when the volume of water available falls, the reduced share to virtually all other purposes results in an increase to agriculture. However, the main reason that agriculture's own share

FIGURE 3
Relative water availability for major consumptive use categories in the Okanagan watershed, above Osoyoos Lake. Horizontal axis marks the reduction in the amount of water available in the watershed, relative to the amount that would satisfy all licenced consumptive volumes. Vertical axis measures the share of the total licence volume in each category that can be withdrawn, if FITFIR *licence priorities are applied throughout the watershed.*



declines almost in line with the decline in water available is that most agricultural water licences are on tributaries that have few upstream licensees. Thus, these agricultural licences have to absorb pretty much all of the reduction in water available. Seniority has little value when there are no upstream junior water users.

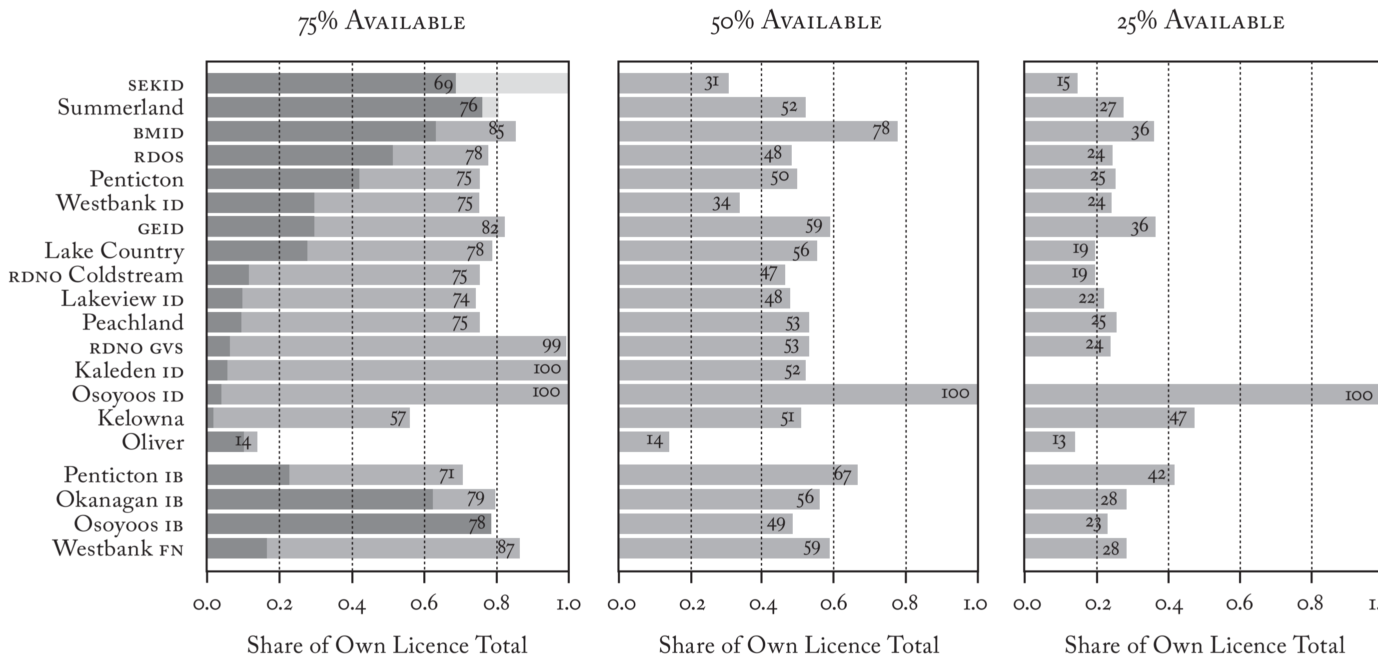
The distribution of impacts highlighted by Figure 3 points to a key question that policy reform must consider, namely, is putting a larger burden on almost all other water uses besides agriculture an appropriate way to deal with drought? Should scarce water go to basic human needs before it is used to grow food since we can import "virtual water" as food from elsewhere?[17] Or should scarce water go first to agriculture because farmers' livelihoods depend upon it, whereas the incomes of non-farm Okanagan residents will not be seriously affected by drought?

Although agricultural withdrawals are generally the last to be cut back under FITFIR, not all farmers hold senior water rights. Further, some large stakeholders are not farmers. While agriculture is the dominant licence purpose, farmers themselves do not hold many water licences; rather, most licences are held by water purveyors – irrigation districts, cities, and so on. Absent an alternative, the interaction between FITFIR and watershed geography will determine how different water licensees will have to adapt to water shortages. Figure 4 shows the share of the total licence quantity that a selection of licensees would be entitled to withdraw for reductions in water availability of 25 percent, 50 percent, and 75 percent below the amount of water necessary to fulfill all licences. The first thing to notice is that all licensees do not see the same reduction in the water to which they have access. Do we still accept that the impacts of a drought should be absorbed differently depending on the identity of a person's water provider? Or should the load be carried more equally? If we don't accept the distributional impacts of a hard enforcement of FITFIR, are we prepared to leave its legal mechanisms in place and trust that, in the event of a drought, senior water users will voluntarily agree to a more equitable sharing of the available water? Another point demonstrated in the figure is that First Nations do not fare all that differently from other licence holders. Should First Nations share water with more recent settlers or do they have a prior right?

The scenarios envisaged in Figure 4 also demonstrate that the effects of FITFIR are greater in the lower reaches of rivers and streams. The City

[17] See, for example, J.A. Allan, "Virtual Water: A Strategic Resource Global Solutions to Regional Deficits," *Ground Water* 36, 4 (1998): 545–46; and S. Brown, H. Schreier, and L. Lavkulich, "Incorporating Virtual Water into Water Management: A British Columbia Example," *Water Resources Management* 23, 13 (2009): 2681–96.

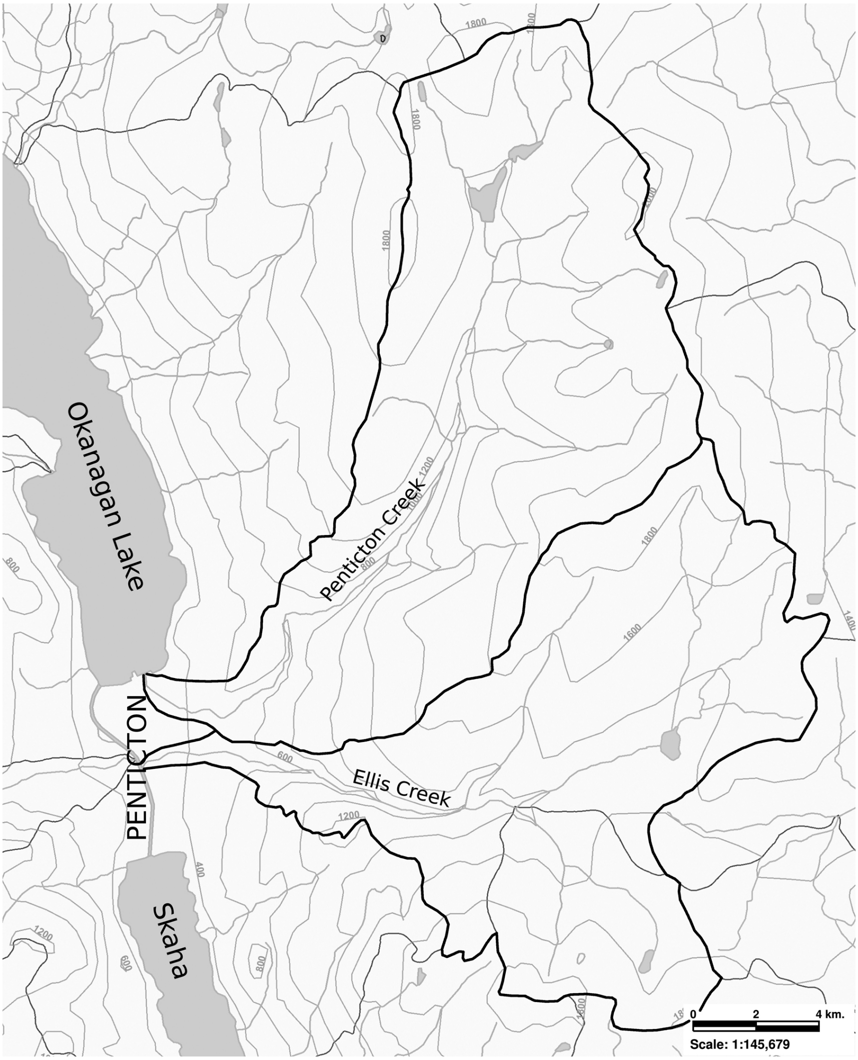
FIGURE 4
Select major water users and the share of total licence volume that can be taken for three different reductions in water availability. Overlay bars in left panel represent relative size of total licence volume. Lower four bars represent largest First Nations listed as licensees.



of Penticton provides a clear example of this. Penticton has water licences on Penticton Creek, Ellis Creek, and Okanagan Lake (see Figure 5). More than 99.9 percent of its licence volume is on Penticton and Ellis creeks, and 99.86 percent of this licence volume has a priority date of 1905 or earlier. Only one water licence on each of Penticton Creek and Ellis Creek is not owned by the city, and those licences are both junior to all of the city's non-storage licences. The city's licences account for 99.78 percent of all the licenced withdrawals from Penticton Creek and more than 99.99 percent of licenced withdrawals from Ellis Creek. In a water shortage situation, the two non-city users would be cut off almost immediately, and the city's withdrawals would shrink to the quantity of water available. This is reflected in Figure 4, where Penticton's share of the available water mirrors the reduction of water in the creeks. Were Penticton to move its point of diversion further down the watershed – by transferring its 1892 priority licences to Skaha Lake, for example, and pumping water into its treatment and distribution system – a large number of junior water users upstream of the lake would have to cut back first. If all of Penticton's licences were shifted to Skaha Lake, then the licence usage rate for Penticton would be 100 percent, 100 percent, and 99.9 percent, respectively, for the three scenarios presented in Figure 4. Those licensees that must cut back to make space for Penticton include the City of Kelowna, which would suffer a small reduction in the third scenario, from 47 percent down to 42 percent of its licenced withdrawals. An alert water controller would likely recognize an application for such a licence change as a move to enhance water access and would block it out of concern for adverse impacts on downstream licensees. However, there have been suggestions that, in order to enhance water quality, to optimize storage, and to better manage instream flows, there should be less reliance on upstream reservoirs and more use of the mainstem lakes in the valley bottom. Designing and building the required infrastructure would likely involve less effort than sorting out the resulting legal implications that flow from FITFIR.

Figure 4 also reveals that treating each water source as a pool distorts reality. SEKID and BMID both withdraw water from the Mission Creek sub-basin. The water sources used by SEKID flow into Mission Creek, on which BMID has licences. According to the model, if BMID licences were senior to those held by SEKID, then SEKID would have to reduce use during a shortage to accommodate BMID licence allowances. However, the withdrawal point used by BMID is above the point where the tributaries used by SEKID enter Mission Creek. The only way that BMID could take advantage of its more senior licences would be to move its

FIGURE 5
Penticton Creek and Ellis Creek



Source: Government of British Columbia Integrated Land Management Bureau, iMapBC http://webmaps.gov.bc.ca/imfx/imf.jsp?site=imapbc (viewed August 2010).

withdrawal point further down the creek. A fuller model would link points of diversion as they are connected hydrologically. Such a model could also allow for minimum stream flows for each portion of the stream between points of diversion. Extensions of the model would also account for the fact that usage is typically well below licence quantity.

WATER MARKETS

The model demonstrates that the allocation of water by FITFIR during a drought would significantly affect which activities and which users have access to the water. If we do not like these outcomes, then we need a mechanism for reallocating water. Currently, such reallocations are typically forced by government, either under the federal Fisheries Act[18] or through the recent provincial Fish Protection Act.[19] Outside of the reallocation that takes place indirectly when people respond to public appeals for conservation and/or voluntary ad hoc arrangements, reallocation of water rights must be arranged through the water controller as a change in appurtenancy. This is a slow process, not suited to rapidly adjusting to short-term needs and opportunities.

The important role that economic incentives play in influencing the decisions of water users was clearly recognized in the 1992 Dublin Statement on Water and Sustainable Development (adopted at the 1992 International Conference on Water and the Environment): "Water has an economic value in all its competing uses and should be recognized as an economic good."[20] Treating water as an economic good requires that the full social costs and benefits of alternative water uses be compared in determining where water is best used. A water market can be a very effective tool for moving water to its most valuable uses when there are limited third-party effects (environmental externalities, etc.) or when the market institution is designed to manage third-party effects. In a number of watersheds around the world, market-type mechanisms are being explored.[21] Much has been written about the advantages and shortcomings of water markets.[22] In principle, there is little difference

[18] Canada, House of Commons, Fisheries Act, 1985, available at http://laws.justice.gc.ca/PDF/Statute/F/F-14.pdf (accessed April 2010).

[19] British Columbia, Legislative Assembly, Fish Protection Act, 1997, available at http://www.bclaws.ca/Recon/document/freeside/–f–/fishprotectionactsbc1997c.21/00_97021_01.xml (accessed April 2010).

[20] United Nations Documents, *The Dublin Statement on Water and Sustainable Development*, 1992, available at http://www.un-documents.net/h20-dub.htm (accessed September 2010).

[21] While there is considerable controversy, the role of economic incentives, including markets, in the management of water allocation is expanding. See David Zilberman, "Emerging Water Policy Trends: An International Perspective," paper delivered at 80th Annual Conference of the Western Economic Association International, San Francisco, July 2006; and Theodore M. Horbulyk, "Liquid Gold? Water Markets in Canada," in *Eau Canada: The Future of Canada's Water*, ed. Karen Bakker (Vancouver: UBC Press, 2007), 205-218.

[22] There are a variety of sources of information on water markets and water trading. For a perspective that emphasizes more economic theory and positive economic analysis, see any of K. William Easter, Mark W. Rosegrant, and Ariel Dinar, eds. *Markets for Water: Potential and Performance* (Norwell, MA: Kluwer Academic Publishers, 1998); Ariel Dinar, ed., *The Political Economy of Water Pricing Reforms* (Oxford: Oxford University Press, 2000); and

between a water market and better water pricing: both put a value on water and force water users to consider the cost of using more water.[23] Where price is used, the cost is what must be paid to the utility. With a water market, the cost is what could be earned by selling the water. For a commodity like water, which is in limited supply, a market lets users find the right price, whereas a utility would have to identify a price high enough to lead to the right amount of water conservation without knowing how much such conservation costs the final users. Further, where there are pre-existing water rights, such as in British Columbia, implementing a water market makes reallocation voluntary. Ensuring that participation in reforms is voluntary for water users was also critical elsewhere (e.g., in Alberta).[24] While the government does have other tools for reallocating water, a water market would seem to provide a simpler and more direct mechanism for determining "fair" compensation than would more technocratic approaches, which rely on some central authority to determine the best use of water and the amount of compensation due those who have their access reduced.

In the Okanagan, as elsewhere, there are a wide variety of water users. The largest number of final users are households, for whom water is a very small part of the budget. Households typically do not worry much about their water unless it stops coming or its quality deteriorates. However, they also recognize that water is vital, and they are suspicious of the idea of buying and selling water rights. In jurisdictions where water rights are tradable, households generally do not participate in the water market themselves; rather, they receive their water from a water utility that owns the rights. As with the current system, if water rights could be traded (i.e., if a market in water were established), households would receive their water through a pipe and pay a bill to their water utility.[25] Tradable water rights would provide the utility with the flexibility to adjust its water supplies in response to long-term demand growth and short-term supply issues. A water market could result in lower water rates if the utility were able to avoid maintaining surplus capacity by purchasing water to cover occasional shortages or by selling

Ronald C. Griffin, *Water Resource Economics: The Analysis of Scarcity, Policies, and Projects* (Cambridge, MA: MIT Press, 2006).

23 In Lorraine Nicol, Henning Bjornlund, and Kurt Klein, "Improved Technologies and Management Practices in Irrigation: Implications for Water Savings in Southern Alberta," *Canadian Water Resources Journal* 33 (2008): 283-94, and references cited therein, farmers typically adopt water-saving technology if it increases yield or reduces cost, not to save water per se. Pricing water makes increasing water-use efficiency a cost-saving investment.

24 Bjornlund, *Competition for Water*.

25 Dosi and Easter, "Market Failure."

water that is surplus to its needs. Such arrangements have been made elsewhere, where utilities have negotiated an option to buy water from irrigators if there is a shortage.[26]

Larger users of water would engage in the market themselves. Farmers in particular are likely to be active participants if they hold water licences. Being able to lease, purchase, or sell water rights would allow farmers to adjust their water entitlements to match their needs. Further, and perhaps more important, unused water would have value, providing a strong incentive to conserve. Experience in the Okanagan and elsewhere has shown that farmers do respond to water pricing, generally finding far more savings than they first thought possible.[27]

Many Okanagan farmers do not hold their own water licences; instead, they are served by irrigation districts (many of which also serve households). Irrigation districts are a form of local government, with responsibility for the delivery of water in a particular area. Irrigation districts hold water licences and deliver a share of the available water to those they serve. Delivery is typically through a pipe network, with the ability to regulate flow at each outlet and, in an increasing number of cases, the ability to meter each user's use. Supplied water users have an annual allotment of water that they can use. They are free to use less than their allotment, but they may be sanctioned if they exceed it. The specific sanctions and the likelihood of their application depends on the bylaws and procedures of the specific water purveyor. Like utilities, irrigation districts can gain from tradable water rights by using the water market to manage fluctuations in water availability. They could use price to encourage conservation. However, they could also follow the Australian model, in which the district's prime role is to deliver water, and farmers hold the water rights.[28] Some do question the ability of Canadian institutions to protect the public interest if water rights

[26] Some examples are discussed in Ari M. Michelsen and Robert A. Young, "Optioning Agricultural Water Rights for Urban Water Supplied during Drought," *American Journal of Agricultural Economics* 75, 4 (1993): 1010–20; Kristiana Hansen, Richard Howitt, and Jeffrey Williams, "Valuing Risk: Options in California Water Markets," *American Journal of Agricultural Economics* 90, 5 (2008): 1336–42; and J. Cui and S. Schreider, "Modelling of Pricing and Market Impacts for Water Options," *Journal of Hydrology* 371, 1-4 (2009): 31–41.

[27] Toby Pike, *Agricultural Water Conservation Program Review* (Kelowna: South East Kelowna Irrigation District, 2005); and Ian Campbell, Toby Pike, Denise Nielsen, and Meriem Aït-Ouyahia, *Does Pricing Water Reduce Agricultural Demand? An Example from British Columbia* (Ottawa: Government of Canada Policy Research Initiative, 2007).

[28] In Henning Bjornlund, Lorraine Nicol, and K.K. Kline, "Challenges in Implementing Economic Instruments to Manage Irrigation Water on Farms in Southern Alberta," *Agricultural Water Management* 92 (2007): 131-41, the authors find that irrigation district managers and board members are very reluctant to support economic instruments, including water markets, as tools for achieving greater efficiencies.

can be transferred.[29] However, such concerns are largely eliminated if water trades occur within the service area of an irrigation district.[30] In Australia, farmers in effect hold shares in the water that their irrigation district has available for delivery. They can then trade short-term water volumes or buy or sell some or all of their shares.

Tradable water rights can also facilitate greater environmental sensitivity and deal with First Nations entitlements in ways that are minimally disruptive. In both cases, the issue turns on securing water rights for uses or users previously ignored (at least to some extent). Tradable water rights can be purchased to protect stream flows or to accumulate rights to help in the settlement of treaty negotiations. Water trades are being used to meet environmental goals in the United States and Australia.[31]

A SURVEY OF IRRIGATORS

In the summer of 2008, seventy-eight Okanagan irrigators were interviewed. The survey collected information on respondents' farms, water systems, the information sources they used to help make farming decisions, how they would adapt to a water shortage, and demographic information. Recognizing that many people have strong attitudes regarding water as a commodity,[32] a number of questions were designed to measure attitudes towards features of a water market, without explicitly naming it as such (survey available on request).

Initial efforts to stratify the sample to ensure balanced representation from farms of different size, with different crops, and with different water sources (private licence, well, water utility) were unsuccessful.[33]

29 Randy Christensen and Anastasia M. Lintner, "Trading Our Common Heritage? The Debate over Water Rights Transfers in Canada," in *Eau Canada: The Future of Canada's Water*, ed. Karen Bakker (Vancouver: UBC Press, 2007), 219-244 .

30 See Lorraine Nicol, "Irrigation Markets in Southern Alberta" (MA thesis, University of Lethbridge, 2005) and references therein.

31 Examples of water purchases for the environment are described in Mary Ann King, "Getting Our Feet Wet: An Introduction to Water Trusts," *Harvard Environmental Law Review* 28 (2004): 495; A. Tasman, *Australia's Working Rivers: The Role of Infrastructure and Water Buy Backs in Recovering Environmental Flows* (North Sydney: Crane Group Limited, 2008); and D. Garrick, M.A. Siebentritt, B. Aylward, C.J. Bauer, and A. Purkey, "Water Markets and Freshwater Ecosystem Services: Policy Reform and Implementation in the Columbia and Murray-Darling Basins," *Ecological Economics* 69, 2 (2009): 366–79.

32 Karen Bakker, "The Commons versus the Commodity: 'Alter'-Globalization, Anti-Privatization and the Human Right to Water in the Global South," *Antipode* 39, 3 (2007): 430–55.

33 The British Columbia Privacy Act prevented any government agency from providing contact information. Non-government organizations such as farmer cooperatives, farm supply companies, and so on, while not legally bound by the privacy act, were also unwilling to provide us with contact information. However, they were willing to allow us to attend some farmer

The sample is therefore biased towards orchardists (78.2 percent in sample versus 65.4 percent of reporting farms), with reasonable representation of grape growers and wineries (12.8 percent versus 8.5 percent) but much poorer representation of other crops.[34] Average farm size in the sample (11.7 hectares) is larger than the average of 6.1 hectares for the Okanagan as a whole.[35] Further, factors such as per hectare revenue and share of time spent working on the farm suggest that the sample is also biased towards farmers for whom the farm is an important income source. The results therefore mainly represent the views of professional orchardists and help to identify differences between orchardists and grape growers and wineries.

The examination of water licences above suggests that there may be opportunities to trade water between agricultural and non-agricultural water licensees in times of scarcity. The experiences during the drought of 2003, as recounted by those interviewed in 2008, suggest that there may be opportunities for trade between irrigators as well. Figure 6 offers two perspectives on the impact of the drought, using irrigators' own assessments of how they were affected. All interviewed farmers were asked if they had enough water in 2003 and, if not, what actions they took to deal with the shortage. The left panel correlates the share of irrigators in each of four irrigation districts who reported having enough water with those who had recently made improvements to their irrigation system, those who had not, those who had more efficient irrigation systems, and those who did not. There is a degree of overlap here as those making improvements will have more efficient systems. However, some efficient systems will have predated the 2003 drought. Except in Black Mtn ID (BMID), farmers who have recently made improvements in their irrigation system were more likely to declare a shortage of water in 2003. The 2003 drought seems to have inspired those farmers who found themselves short to invest in upgrading to a more efficient system.

The right panel shows that grape growers reported having at least enough water in 2003. Except in Oliver, those now growing cherries reported a higher incidence of water shortage in 2003, and apple and pear growers fall somewhere in the middle. Grapes tend to need less water than tree fruits, and grape quality can be enhanced by water

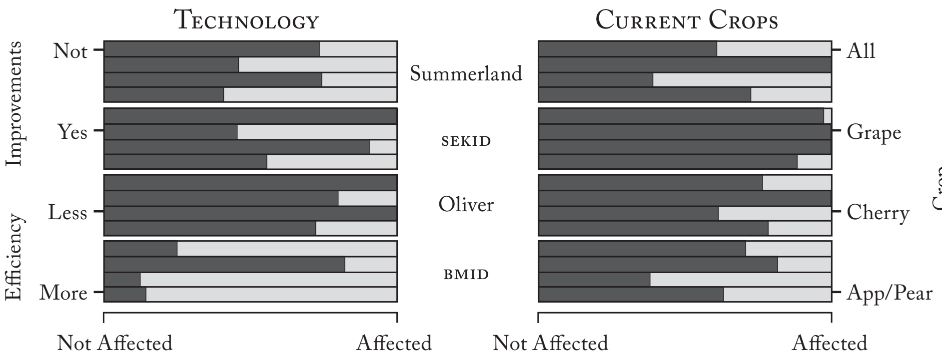
meetings, and the BC Fruit Growers' Association allowed us to include information and a postage paid postcard in one of its mailings.

34 Statistics Canada, 2006 Census of Agriculture: Farm Data and Farm Operator Data, available at http://www.statcan.gc.ca/ca-ra2006/index-eng.htm (accessed August 2010).

35 Ibid.

FIGURE 6

Relationships between technology choice and crop choice, and personal assessment of 2003 drought impact. Each horizontal bar represents total land area of respondents in that category, with dark share showing share operated by respondents who reported having adequate water. Quartets of bars are results for responses from each of the four named purveyor areas. Left quartet has top two bars showing presence or absence of recent improvements to irrigation systems, and bottom two reporting for more or less efficient irrigation systems. Right quartet reports total and three main crops.



stressing the plant.[36] Grape growers therefore are likely to have water to spare while others are going short, which is borne out by the responses. This suggests that, during the 2003 drought, there were opportunities for reallocating water, particularly from grape growers to tree fruit growers. These opportunities existed within the same distribution systems, which means that the transfers were technically feasible. However, water purveyors do not have a process for making such reallocations. A water market would have provided a means of achieving this.

The survey included thirty-five attitude questions measured on a seven-point Likart scale, from strongly disagree to strongly agree. Ten of these questions were specific either to those served by an irrigation district or to those who held their own water licence. The remaining twenty-five were general attitude questions. Given the small sample size, unanswered questions were scored as "neither agree nor disagree." A factor analysis of the responses to the twenty-five attitude questions (see Table 2) identified two factors as explaining 25.5 percent of the variance in responses. When factor analysis was applied to an

36 Elias Fereres and Maria Auxiliadora Soriano, "Deficit Irrigation for Reducing Agricultural Water Use," *Journal of Experimental Botany* 58, 2 (2007): 147–59.

TABLE 2
Factor loadings on market-related attitude questions for all attitude responses and market-related subset

	All responses		Market subset	
	Factor #1	Factor #2	Factor #1	Factor #2
Water is so essential it would be wrong to sell it.	0.518	-0.219	0.524	-0.234
Trading water would encourage conservation and thereby benefit the environment.	-0.169	0.983	-0.156	0.756
A water market would give me more options during a shortage.	-0.260	0.713	-0.142	0.956
Knowing water I save helps another farmer will encourage me to conserve.	0.171	—	—	-0.186
Farmers are unlikely to have faith in a water trading system.	0.783	-0.235	0.750	-0.310
Farmers will try to back out of water trades.	0.700	—	0.812	—
Water trading will lead to a higher price for water.	0.699	-0.283	0.670	-0.301
A water market will be used by developers to take water from agriculture.	0.722	—	0.654	-0.233
Proportion of variation	0.161	0.094	0.304	0.227
Cumulative variation	0.161	0.255	0.304	0.531

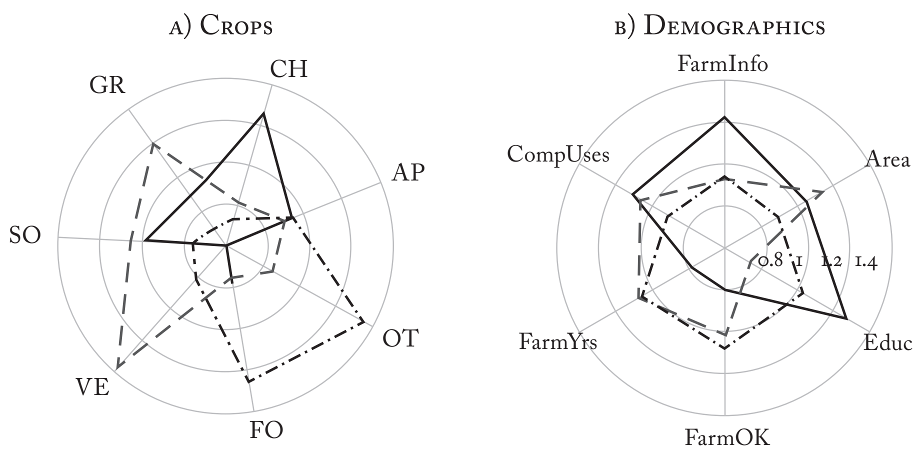
eight-question subset that related to water trading, the same two factors explained 53.1 percent of the variance. The first factors from each approach had a correlation of 0.931 and the second had a correlation of 0.921, suggesting that there was no consistent pattern among the responses to the seventeen questions not related to water trading.

The two factors can be labelled as (1) trading water will harm agriculture and (2) trading water will benefit society. The first reflects the position of agriculture in relation to water. Fears about the loss of water to developers correlate with concerns about the impact on the irrigator's own operation, from fear of higher prices to regulations that are not dependable. Thus, it follows that those who score high on this factor are also likely to see selling water as wrong. The second factor rests strongly on the idea that trading water will benefit the environment and that trading water can benefit the irrigator when water is scarce. Strong scores on these two factors tend to correlate with low scores on the faith and price questions, implying a belief that dependable regulations for water trading can be developed. It also follows that, when the score is high on this factor, selling water is not seen as wrong.

Cluster analysis was used to identify groups of respondents who gave similar answers to the attitude questions. The results suggest two or three groups. Using three, the groups can be described as relatively

FIGURE 7

Crop area and select demographic variables, organized by cluster. Solid line joins cluster that is positive towards water trading, and dash-dot line joins cluster that is extremely negative towards water trading.



positive towards water trading, extremely negative, or intermediate. With two, the intermediate and relatively positive groups are united into a somewhat positive group. Averages for a range of variables were then organized by group to identify variables associated with group membership. Figure 7 shows the crop area share and the relative score on a selection of demographic variables for each group.

Panel (A) shows that farmers who are the most negative towards water trading tend not to grow cherries (CH), grapes (GR), soft fruits (SO), or vegetables (VE). While the number of people growing crops other than apples is small, these results suggest that those specializing in non-traditional crops tend to be less negative towards water trading. Panel (B) shows group differences along a number of demographic variables, where values are scaled by the mean level. Those who are the most negative towards water trading tend to have relatively smaller farms (Area), make less use of computers (CompUses), and have been in the Okanagan for longer (FarmOK). In contrast, those who are the most positive towards water trading are more educated (Educ), use computers for many activities on the farm, consult more sources of farm information (FarmInfo), and are relatively new to farming (FarmYrs).

In the Saint Mary's Irrigation District of southern Alberta, graduate research by Lorraine Nicol found that sellers and non-participants in the water market who report being knowledgeable about their trading options tend to be younger and more educated, while those older and more educated report the highest knowledge levels among buyers.[37] To the extent that it takes time to establish a commercial enterprise, Nicol interprets the effect of age on buyers as reflecting agricultural experience. For the Okanagan, more educated and innovative farmers are less opposed to the market, which concurs with Nicol's results; the fact that those who have been farming longer, and have been in the Okanagan longer, are more opposed seems to contradict her results. However, this may reflect high land prices in the Okanagan: prospective farmers must have accumulated wealth elsewhere, and, as this may reflect business experience, such farmers may be less opposed to participating in a water market. Fundamentally, Okanagan irrigators are not of one mind on water trading, and the "next generation" of irrigators seems more open to water trading than the "last generation."

[37] Nicol, "Irrigation Markets."

DISCUSSION

Water has been recognized as a critical resource in the Okanagan for as long as people have lived there. First Nations people recognized a special relationship with the water, and immigrants from beyond North America engaged in extensive projects to make the most of what water there was. There is now little "new" water available to satisfy growing demands, both for ecological needs and for new uses and users. The current challenge is to make the most of this limited supply. This will almost certainly mean that some people will have to make do with less.

Reallocating water is a challenge. It is difficult because few people will gladly make do with less. It is further complicated by the intricate relationship between the water licences held in the basin. The way these licences prioritize uses and users is a historical artefact and may not reflect society's current values and goals. During a drought we almost certainly want to ensure that everyone has access to basic human needs, even if that harms some agricultural producers. However, we also want to ensure the continued viability of Okanagan agriculture, something that will be compromised if Okanagan farmers cannot depend on their water supply.

If there is a limited supply of water, then total use will have to fall to match supply. How total use falls depends on a collection of water-use decisions made by individuals, be they irrigators, home owners, business managers, or whatever. Typically, reductions can be achieved through many different patterns of individual water-use reductions. The challenge of water reallocation is the challenge of finding the best pattern of water reductions. At the one extreme, responsibility for ranking these patterns can be conferred on an administrative authority; at the other, it can be delegated to the individual water users who know best their own situation and how they would be affected by using less water. What is missing is a way for these individuals to rank the value of using a bit more water themselves against conserving and making that water available for someone else. If we can "get the price right," then individuals can be left to make their own water-use decisions while collective interests are attended to.

I suggest that water trading is one way to get the price right. It does so without requiring a central authority to know what the right price is. By determining how much water can be used without putting at risk important social and environmental values, a central authority operating a water market can leave it to individuals to figure out patterns of water use. In British Columbia, we already use similar systems in supplymanaged industries and in a number of fisheries. Before we find ourselves in the midst of a serious drought, we should develop the foundations for a water-trading system for the Okanagan. We have the opportunity to develop and gradually implement a system that can capture the benefits a water market can provide, while ensuring appropriate protections for the environment and other social goals. The alternative of waiting for a crisis to force our hand, and then attempting to fix the mistakes made, is a far more costly way to proceed.[38] With the Water Act under review, now is the time to build provisions into that act to support the implementation of a market system.

[38] With reference to the Australian experience, Bjornlund makes the same argument for Alberta. See Bjornlund, *Competition for Water*.