



Water for Food **In a Changing World**

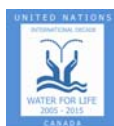
*Strategic Lessons & Opportunities for
Alberta & Canada*

**Derived From the Rosenberg
International Forum on Water Policy**

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A Report for the Max Bell Foundation
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Converging Global Food & Water Trade-offs

Water for Food in a Changing World

Author's Note

The following report represents the observations of just one of the participants of the Rosenberg International Forum on Water Policy held in Zaragoza, Spain in June of 2008. It should be noted that, while reviewed by the Chair of the Forum, Dr. Henry Vaux, other participants were not called upon to make observations on the meaning and value of the proceedings or their outcomes in a specifically Canadian context and may have different views based on their experience abroad.

It should also be noted that there are some materials and sources to which reference is made in this report that were not part of the Rosenberg VI proceedings. They have been included because they are held to be directly relevant to the issues we face with respect to water resource management particularly in the Canadian West.

Readers or researchers with specific interests in the proceedings of this forum are invited to view all of the papers that were presented in Zaragoza and at other forums on the Rosenberg International Forum on Water Policy website <http://rosenberg.ucanr.org/>.

A 244 page, illustrated day-by-day report on the forum, including full analysis of each of the papers presented as well as in-depth consideration of the lessons learned elsewhere that may have application in the Canadian context is available through the author at sandford@telusplanet.net.

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Lessons For Canada & Alberta from Rosenberg VI

Executive Summary

Globally, we are converging simultaneously on both food shortages and water scarcity. These two trends will in tandem have huge implications for the economy of Canada and the way of life of Canadians.

The first implication is that we should expect the same kinds of water supply and quality issues that are appearing elsewhere to make their presence known in Canada. We should recognize that serious problems with respect to water supply can develop even in the absence of drought if population pressures on limited water resources are not exacerbated by climate change. Population growth in southern Alberta will put pressure on local water resources just as surely as they have in southern Spain. Global warming could just as easily and suddenly reduce the amount of water available on the prairies as it has in Australia and in the Mediterranean.

As the Australian example clearly indicates, climate is variable and that variability can affect every sector of a national economy immediately. Climate change impacts can also extend rapidly far beyond known ranges of variability and can also become permanent. If there is a lesson for Canada in this it may be that we should take neither water demand nor hydrological stationarity for granted.

Lessons from elsewhere suggest we should be preparing now for water scarcity in parts of the country while at the same time ensuring we know as much as we can about the potential impacts of this scarcity on those places that remain relatively water abundant.

We should expect growing tension between big urban centres and the agricultural community as more demands are placed on limited water resources and as the threat of prolonged drought increases as a consequence of climate change.

The second implication of converging global food shortages and water scarcity relates to the role Canada already plays in producing the world's food. Groundwater overdraft and climate change are already affecting many established food growing regions such as China, India and the United States. This will put greater pressure on remaining food producing countries to increase productivity. Increasingly, the response to global water scarcity will not be defined direct transfers of liquid water between regions and countries, but by how much water is traded among nations in the form of water embodied in food. The favouring of virtual water exchanges could greatly advantage Canada's agricultural sector, but only if it is able to address its own serious issues relating to the sustainability of agricultural practices especially as they relate to impacts on water quality and quantity.

Given that the world will likely be relying upon us more heavily than ever to meet increasingly unattainable global food production goals, Canada's future economic success may well be defined by how carefully and productively we manage our water resources. We cannot, however, avoid the same kinds of problems other countries are facing with respect to water resources and at the same time increase our agricultural productivity unless we quickly get our own water management house in order. Canada's future economy will be defined in increasing measure by:

1. our ability to dispel our own myths of limitless abundance;
2. our willingness to integrate the management of ground and surface water;
3. how well we improve the monitoring of surface and groundwater quantity and quality and the extent to which enhanced monitoring leads to improved water availability forecasting and long-term climate change prediction;
4. our success in making the link between water and energy;
5. how quickly we can instil a conservation imperative into our society;
6. how quickly we embrace eco-hydrological realities and come to understand and protect ecosystems and ecosystem functions that generate clean water;
7. our success in solving our own water availability and quality challenges related to agricultural practices;
8. the extent to which we reverse the growing eutrophication of our lakes, watercourses and estuaries;
9. our willingness to reassess policies with respect to biofuel production in the context of its impact on water supply, land-use and the future availability of productive farmland;
10. our effectiveness in anticipating and managing the growing likelihood of prolonged drought;
11. our willingness to anticipate climate change impacts on both water supply and quality;
12. how well the markets we create to manage water allocation reflect not just the opportunity to make money but respect inter-generational equity and the need to achieve true sustainability;

Action in each of these linked domains hinges on the extent we can effectively summons the courage to reform our nation's administratively fragmented and jurisdictionally territorial water governance structures in service of these goals.



Lessons From Rosenberg VI

What Is the Rosenberg Forum?

The Rosenberg International Forum on Water Policy was created in 1996 by the Bank of America with an endowment gift to the University of California in honour of Richard Rosenberg upon the occasion of his retirement as Chairman of the Bank. The resources from this gift support the Rosenberg International Forum on Water Policy. The theme of the Forum is: Reducing Conflict in the Management of Transboundary Water Resources.

The Forum meets biennially at different locations around the globe. Past Forums have been held in San Francisco, CA, USA; Barcelona, Spain; Canberra, Australia; Ankara, Turkey and Banff, Canada. Attendance at the Forum is by invitational only and is restricted to 50 water scholars and senior water managers from around the world.

The Advisory Committee of the Rosenberg Forum wish to thank the Max Bell Foundation which supported the derivation of these lessons for Canada and Alberta from the proceedings of the Sixth Biennial Rosenberg International Forum on Water Policy which was held in Zaragoza, Spain in June of 2008.

Part One: Emerging Development & Issues

Converging Global Trade-offs

The underlying theme that emerged throughout this forum is that food shortages and water scarcity are simultaneously intensifying around the globe. These two trends will in tandem have huge implications for the economy of Canada and the way of life of Canadians.

The first implication is that we should expect the same kinds of water supply and quality issues that are appearing elsewhere to make their presence known in Canada. We should recognize that serious problems with respect to water supply can develop even in the absence of drought if population pressures on limited water resources are not exacerbated by climate change. Population growth in southern Alberta, for example, will put pressure on local water resources just as surely as it has in southern Spain. Global warming could just as easily and suddenly reduce the amount of water available on the prairies as it has in Australia and in the Mediterranean.

The second implication of converging global food shortages and water scarcity relates to the role Canada already plays in producing the world's food. What is happening at the nexus of food and water scarcity worldwide will affirm Canada's already important place in the global food and water economy.

Growing global food production and water supply troubles will back up into our purview from the outside. Worldwide approximately 16% of agricultural soils are currently degraded with significant impacts on food production, rural incomes and national economies. The potential to expand the global cultivated land area is nearly exhausted demanding that available water resources be used more efficiently, especially given that global fish stocks are also in decline.

In many areas of the world, persistent groundwater overdraft threatens accustomed supplies because a point will be reached when aquifers will be economically exhausted in that the cost of pumping will exceed the benefits of any use to which the water may be put. Groundwater overdraft and climate change are already affecting many established food growing regions such as China, India and the United States. This will put greater pressure on remaining food producing countries to increase productivity.

Instead of waiting for a crisis, Canadians may well wish to put lessons learned elsewhere by others into active relief. Given that the world will likely be relying upon us more heavily than ever to meet increasingly unattainable global food production goals, Canada's future economic success may well be defined by how carefully and productively we manage our water resources.

We cannot, however, avoid the same kinds of problems other countries are facing with respect to water resources and simultaneously increase our agricultural productivity unless we quickly get our own water management house in order.

Virtual Water Export

Increasingly, the response to global water scarcity will not be defined by direct transfers of liquid water between regions and countries, but by how much water is traded among nations in the form of water embodied in food. As of the year 2000, about 1000 cubic kilometres of water were traded from nation to nation in the form of food. The volume of virtual water transported around the world in this way amounted to about 15% of the total amount used currently in food production. This, however, is not a straight-forward calculation.

Assuming that crops grown for trade would also be grown in the absence of that trade, virtual water export savings will vary considerably depending on the crop. The trading of wheat and corn, for example, has resulted in an estimated 41% to 59% reduction in global water use respectively. As a result the trading of these two crops contributes significantly to total global water savings.

Because of crop water productivity, 73 cubic kilometres of virtual water exported from North America is worth the equivalent of 149 cubic kilometres of water when these crop products are imported into East Asia, which represents a doubling of effective value.

While the volumes are smaller the percentage benefit of exporting to very dry places such as the Middle East is even greater. Here a volume of 17 cubic kilometres of virtual water exported from North America is worth 55 cubic kilometres locally, a near tripling of volume.

North and South America and Australia are the only places in the world that export virtual water benefit. All other regions are net importers of virtual water. If, as models predict, some 53% of the population of the world in 2050 is facing one form or another of water scarcity, then countries that need to make up for inadequate water supply by having to import water virtually as food will require a virtual global transfer of 7500 cubic kilometres of virtual transfer a year.

Since present food trade is principally between the industrialized countries, this represents more than a doubling of food trade internationally between now and 2050, which is no minor proposition – especially for Canada. Some experts have predicted that as a result of that trade agriculture will ultimately become more important to the economy of Western Canada than oil and gas. To take advantage of this opportunity, however, we have to improve our agricultural practices especially relating to the management of water resources.

Cities & Agriculture Competing With One Another & Nature for Water

Water supply in urban areas in many parts of the world is becoming more expensive to assure. The reasons for this include higher costs to develop more distant sources, more complex and therefore more expensive source development, the greater need for higher-cost treatment facilities and the lack of flexibility of other users of low-cost water.

In discussing the lack of flexibility of other users of low cost water, participants in the Forum pointed to irrigation farmers.

The unwillingness of the irrigation agriculture community globally with respect to the sharing of low-cost water with cities should be of interest to policy-makers in Alberta. This is especially true given that the province's two major cities may be facing challenges, in one case, to how much water to which they have been entitled; and in the other case to the amount of water available for future growth and development.

If what is happening elsewhere in the world is any indication of what will happen as our populations grow it is reasonable to expect that in the future there will be tensions between cities and surrounding agricultural regions over water allocation and use.

As a result of this tension we should anticipate challenges to the existing first-in-time, first-in-right water allocation doctrine upon which current water rights have been established. This does not mean, however, that Alberta should be rushing to take water away from agriculture to put it to higher economic use.

As has already been pointed out, rising food prices globally and threats to food production capacity caused by groundwater overdraft in other parts of the world are likely to make Canada's food-producing capacity central to the stability of international food supply – provided, once again that agriculture can become sustainable.

The Small but Important Matter Of A Common Definition of Sustainability

The consensus of the Rosenberg Forum was that contemporary discussions about sustainability were largely irrelevant because we do not as a society act on a common vision of what sustainability means. Sustainability has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. That said, many expert participants lamented the substance-less manner in which the term “sustainability” had been appropriated by so many public and private interests today. There was a sense that, in the absence of a common understanding of the meaning of the term that we have adopted by default a consensus view of what we want sustainability to be like that doesn't reflect reality.

A number of participants in the forum were concerned that despite the high hopes and expectations of the academic and professional water community with respect to Integrated Water Resource Management and the Adaptive Management practices associated with it, the actual prospects for the delivery of purported benefits are no better than fair.

It was noted that while Integrated Water Resource Management and attendant Adaptive Management have great appeal to specialists, actually delivering on these ideas presents a number of political, institutional and equity issues. A big part of the difficulty of Integrated Water Resource Management is that the scope and scale of its ambitions may be too great to achieve. If each of the single elements that have composed Integrated Water Resource Management ambitions were in the past difficult to achieve individually then all of the other components in combination pose an almost insurmountable implementation challenge.

These include the recognition of the full range of uses of water; the recognition of in-stream flow needs; the desire to integrate water and land-use policy and the flexible, equitable allocation of water rights – all together. When you can't even do one of these things well enough to ensure achievement of whatever you define as sustainability, how are you going to reform entire water management systems in ways that will permit implementation of all of these elements simultaneously?

Seen in this light, a common definition of sustainability becomes the bedrock upon which all future possibility must be built. New understanding about how ecosystems generate and purify water will also become part of that foundation.

The Emerging World of Eco-hydrology Or Why Nature Needs Water

Rich biodiversity provides insurance against changes in ecosystem processes that may impair service provision. Differences in species responses to disturbances and environmental extremes make it unlikely that over time scales of decades or centuries there is much ecological redundancy in the species composition of a functioning ecosystem. In other words, biodiversity imparts resistance and resilience against disturbances that disrupt ecosystem function and that world in less diverse situations reduce or diminish the benefits it can provide to itself and to humans.

The problem in our time is that biodiversity is being irretrievably lost in many of our ecosystems before it's economic and survival value can be proved or evaluated. We are tearing apart a system that was designed by nature to deal with decades to centuries-long variability. In so doing we are exposing ourselves to huge adaptive vulnerability. Nowhere is this more so than in the domain of water supply.

What is different about the eco-hydrological approach to water resources management in the Canadian context at least is that it is arguing that the precautionary principle should be applied also to biodiversity concerns related to the provision of one specific ecosystem benefit – the supply of fresh water. The “precautionary principle”, an inconsistently applied dictum that holds that where there is a threat of significant reduction or loss of biodiversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

Emerging eco-hydrological principles associated with this emerging worldview demand that we ask what may well be the question of the century. The issue at stake, in this context, is not how much water we need to allocate for “nature” at the expense of people so that “nature” is somehow sustainably maintained. The really important question is how much water can be allocated for driving current trends of global population and economic growth without reducing and degrading ecosystem services to the point that they can no longer support either people or nature.

Nature is of survival value for people and much of its survival value is established through its provision of water.



In order to provide water and other critical benefits to people nature needs water, too.



It follows, hence, that nature should be considered a legitimate water customer.

What eco-hydrologists are claiming is that, in dryland areas at least, the sacrifice of important and valuable water supply, regulation, self-purification and biodiversity-enhancing ecosystem services to the single purpose of agricultural food production may have disastrous consequences.

Eco-hydrologists like Uriel Safriel are of the opinion that over-development of agriculture or urban infrastructure actually results in measurably less water availability for both people and nature. From an eco-hydrological point of view, agri-monocultures and urban monocultures do the same thing to water. Both reduce the amount that can be absorbed by soils and captured and made available to surrounding vegetation.

Agri- and urban-monocultures dry out adjacent areas by reducing the sponge capacity of once diverse plant communities that surrounded them. They suck up all the water for their needs which leaves less for surrounding areas which affects both water quality and quantity.

From this one can see that despite their small area globally, aquatic ecosystems are of extraordinary nominal and relative value. While all freshwater ecosystems on Earth together comprise only 2.4% of all non-marine ecosystems they provide 40% of the value of all of these ecosystems combined. The average annual value of services per hectare of a freshwater ecosystem is 16.8 times that of an average hectare of a non-marine system.

In direct association with the water cycle aquatic and terrestrial ecosystems also play a huge role in determining the nature and character of the Earth's atmosphere. As the service of climate regulation is principally provided on behalf by vegetation and since the growth of vegetation is determined in much of the world by water availability, a reduction in the allocation of "nature" would exacerbate global warming.

This suggests that the more water we take for ourselves at the expense of aquatic and terrestrial ecosystem health as defined by biodiversity the more we are contributing to global warming. Simplifying dryland ecosystems like the Canadian prairies has no less an effect than deforestation in more humid regions. The added effect of wetland drainage not only contributes to nutrient loading and pesticide and other contaminations of diminished prairies rivers it exacerbates climate change by creating a positive feedback to rising temperatures which will lead to desertification and even higher temperatures.

All this – eco-hydrologists say - because we have over-allocated water to such an extent we no longer have enough to give to "nature" so that it can provide the service of climate regulation on our behalf. This should not be seen as a criticism of engineering. The point that evolving eco-hydrological perspectives put into relief is not that we should stop relying on engineering solutions. We can't go back now even if we wanted to. If anything we need solid engineering solutions more than ever. But we do need to know more about how urban and agricultural ecosystems can be made to contribute more to both water supply and quality.

We need to improve our understanding not just of fundamental eco-hydrological function, but of the expanded services that our natural, agricultural and urban ecosystems might be able to provide in the future and engineer toward the realization of that potential. There is some urgency in this in that we are converging on some very difficult trade-offs.

We Are Converging On Difficult Trade-offs

About 40 percent of the surface of the solid Earth receives so little precipitation that natural ecosystem function is limited by water availability. Currently, global human population growth is the highest in places where there is the least water. Thus we find that globally a third of humanity is now competing directly with nature for water. More water resource development, especially in semi-arid and arid regions of the globe, will lead to greater damage to both freshwater and non-aquatic ecosystems, which will lead directly to the decline of our global life-support capacity and ultimately to diminishment of human well-being.

It is estimated that to meet the food demands that are projected to exist in the world in 2025, we will need to put an additional 2,000 cubic kilometres of water into irrigation. This amount is roughly equivalent to 24 times the average flow of the Nile. Given current water-use patterns, the population that is projected to exist on the planet in 2050 will require 3,800 cubic kilometres of water per year, which is close to all the freshwater that can presently be withdrawn from the surface on Earth. This would mean that the world would lose most of the important environmental services that aquatic ecosystems presently provide on our behalf. Clearly, that is just not going to happen. Something would give first, either the environment itself or, perhaps more likely, our social order. Both are already under stress.

We are already beginning to observe that rapidly expanding urban centres have begun to compete with agriculture for both land and water on a global basis. Agriculture has, in turn, begun to compete with nature for land and water. We are increasingly concerned that we cannot meet both agricultural and urban needs while at the same time providing enough water to ensure the perpetuation of natural ecosystem function.

As a consequence of growing populations and increased competition for land and water, humanity is converging upon the need to make uncommonly difficult public policy trade-offs that have never had to be made on a global scale before. If we provide to nature the water it needs to perpetuate our planetary life-support system, then much of that water will have to come at the expense of agriculture, which means that many people will have to starve to meet ecosystem protection goals. If, on the other hand, we provide agriculture all the water it needs to have any hope of feeding the populations that are projected to exist even in 2025, then we must expect ongoing deterioration of the biodiversity-based ecosystem function that has generated Earth's conditions upon which our society depends both for its stability and sustainability. These are difficult political choices.

Specific Implications for Alberta & The Prairie West

Thus we see the challenge before us of creating sustainable water management in Canada. By building a better bridge between science and public understanding that leads to policy action, it is still possible for us to create the West we want, but it will not be easy.

If we want to avoid the kinds of problems other semi-arid regions like Australia, Spain and the American Southwest are facing, massive reform is no longer an option. It is an urgent necessity.

We should expect public policy reform to be difficult and time-consuming. We should expect the change process to take a great deal of collaboration and to take years to generate lasting results.

No single management action, legislative package or policy framework can respond to all of the problems that are presently converging around water availability conflicts especially as they relate to the disproportionate amount of water demanded by irrigation agriculture in parts of Canada. National and regional policies must be integrated and water strategies must somehow be integrated into agricultural policies if water scarcity challenges are to be fairly and equitably resolved now and in the future.

We should expect to have to manage conflict over allocation and water use priorities as part of the process of change. We should expect change processes to go on for generations because the problems are likely to become more and more complicated as they converge around increasing global populations and climate change.

Part Two: Getting Our House in Order

The implications for Canada of our own water problems and of emerging eco-hydrological pressures elsewhere in the world are significant. Given that the world will likely be relying upon us more heavily than ever to meet increasingly unattainable food production goals, Canada's future economic success may well be defined by how carefully and productively we manage our water resources.

Before we can begin to realize opportunity in what is happening elsewhere, we need to get our own house in order. In the context of water resources management our future economy could be defined in increasing measure by continuing improvements in at least a dozen areas.

1.

Dispelling the Myth of Limitless Abundance

The first challenge may wish to address relates to self-perception. We have to dispel the myth of limitless water abundance in Canada or we will continue to make public policy choices based on false assumptions that could have undesirable ecological, social and political consequences in the future. We may have 20% of the world's fresh water resources, but much of that is water in the bank left after the last ice age. We have only 6.5% of the world's *renewable* water resources and most of that is found in the north.

We spend far too much time in this country worrying about water exports and not nearly enough time thinking about the damage caused by our own management choices. If the Americans want our water, or if we want more in the south, we are going to have to go north to get it, and that will be very, very expensive.

The lesson here is that we have to be careful not to make ourselves vulnerable by making political decisions based on false assumptions about how much water we actually have. We have to solve our own problems first, before we satisfy the thirsts of others.

Recommendation

We must continue and expand our efforts to educate Canadians about the extent, state and importance of our water resources.

2.

Integrating Management of Ground & Surface Water

The alarming state of our country's groundwater resources was put into relief in a report by the Council of Canadian Academies. This report evidences that while some groundwater situations in Canada, such as the Oak Ridges Moraine region in Ontario, are being managed sustainably, contamination of groundwater aquifers is widespread all over the country. We are even contaminating aquifers we share with the U.S. The panel composed of this country's best hydrologists also pointed to long-term problems we have created for ourselves by denying the seriousness of ground and surface water issues related to projects like the oil sands.

Recommendation

All of these problems can be resolved but not without much strengthened and better integrated public policy and much improved monitoring and predictive modelling.

3. Improving Monitoring, Forecasting & Long-Term Prediction

Everyone in the water-stressed world is calling for improved seasonal water availability forecasts but very little money is being invested in the monitoring, data collection and interpretation that are necessary to make improvements in this kind of forecasting possible.

While there is a considerable amount of monitoring being done at lower elevations in some areas of Canada, it was repeatedly noted that there is a crucial need for enhanced hydrological and meteorological observations and associated predictions in the high mountain headwaters of western Canada where there is currently little monitoring activity. This is critical because it is at these elevations that climate change impacts are expected to be felt first and where they are expected to be most pronounced in terms of their impacts on water supply.

The station densities at high elevations in Canada's mountain West are so small that the numbers are difficult to conceptualize. As Dr. John Pomeroy at the Centre for Hydrology at the University of Saskatchewan has pointed out, there are significant gaps in our monitoring of water resources. There are lots of stations at lower altitudes, but few at upper elevations where important changes may be taking place.

In lower elevations in the Rocky Mountain West there is a weather station for every 550 square kilometres which is double the World Meteorological Organization standard for precipitation stations. The story changes, however, above 1500 metres in elevation. At and above this elevation the area sampled for year-round precipitation averages 5500 square kilometres per station.

Above 1500 metres in elevation, the hydrometric station density is 5½ times lower and the precipitation station density is from 3 to 23½ times lower than World Meteorological Organization minimum standards for hydrological analysis in mountainous regions.

Recommendation

A foundation needs to be laid for determining where new monitoring capacity should be established at upper elevations in the western mountains, what new monitoring stations should be measuring, what new remote sensing technologies can be employed to do that monitoring and how collected data will be collected, stored and ultimately translated into useful information that can be shared in a timely manner among water users, water managers, policy-makers and the public.

More also needs to be done to derive meaning and optimal value out from the data that is already being collected and will be collected in the future and that to be of greater use such interpretations had to be shared more effectively between researchers, water management agencies, major water users and policy-makers.

4.
Making the Link Between Water & Energy

Most Canadians have yet to make the link between water use and energy costs. It takes a lot of water to produce energy and a lot of energy to move water. Water is heavy. It takes a great deal of energy to abstract, treat, distribute and re-treat it for further use. Leaving your tap run for 5 minutes costs the same as letting a 60 watt bulb burn for 14 hours. That calculation does not account for the downstream cost of greenhouse gas emissions.

Recommendation

A massive public education program will be necessary to change the water use habits of Canadians. This program should likely be tied into the education required to ensure we understand the actual and potential effects of climate change and how we can mitigate them and adapt to their impacts.

5.
Instilling a Conservation Imperative into Our Society

Is there a water crisis in Canada? No. But in parts of Canada – and especially in southern Alberta – we have all the makings of one.

Because our population is growing, there is greater pressure on our water resources from agricultural and industrial use and more of our water is unfit for other uses because we pollute it. We can avoid a water crisis, or put it off for decades while at the same time saving billions in infrastructure costs, if we make conservation a habit and concentrate fiercely on protecting the quality of our water resources.

Recommendation

In order to make room for the future and for those who will populate it, water conservation should not be an option anywhere in the dry West.

6.
Recognizing Nature's Need for Water

If we do not recognize nature's need for water, there will not in the end be enough water for cities, agriculture or nature.

Recommendation

We need a thorough reassessment of the role ecosystems play in water supply and quality in the Western Canadian context. We need to identify and quantify the services provided

by each regional ecosystem type. We also need to identify the optimal and minimal water required by each of these ecosystems for securing the sustainability the provision of their services.

We need to determine which of the ecosystem types within the landscape proposed for development play landscape-relevant keystone roles, and explore means to maintain ecosystem processes.

We need to identify species that are endangered or at risk of becoming endangered, assess the contribution of each to water-related as well as other ecosystem services.

We need to evaluate the amount of water lost through appropriation of different ecosystem types by agriculture and urban development, for generating guidelines to be followed in land use allocation in areas planned for future development.

We need to study the role of freshwater ecosystems in treating wastewater of various qualities; the degree to which freshwater allocated to natural ecosystems can be replaced by treated wastewater; and the technologies appropriate for this substitution.

7.

Improving Agricultural Practices

The first problem relates to agriculture's impact on water quality. Agricultural water use is becoming an issue globally because contemporary industrial-scale food production practices inevitably result in reduced return flows to nature of water of poor quality which diminished and often water-starved natural systems no longer have the capacity to purify.

The second issues relates to crucial role in agricultural productivity. Unless we manage our water more efficiently and diminish nutrient loading of our western rivers, we may not be able to take full advantage of our opportunity to serve the world by exporting water virtually to water-scarce countries elsewhere.

Recommendation

We need to accelerate the effectiveness of programs that encourage producers to create Environmental Farm Plans that reduce the impacts of agricultural practices on water quality and quantity. In order to ensure results such plans may have to become mandatory.

We need better monitoring of water quality; more enforcement of water quality standards, and further integration of agricultural policy with combined land-use regulation and water resources strategies. We need to move on this integration immediately.

8. Reversing Eutrophication

Many of our big agri-monocultures are drying out the landscapes around them by constraining and then altering the chemical, physical and biological properties of the landscapes they occupy resulting in changes that radiate outward from cultivated areas to untransformed surrounding regions. Just after the Rosenberg Forum, Ducks Unlimited Canada completed Phase I of a multiphase, multi-partner research project to determine the impacts of wetland loss and associated drainage activity in the Broughton's Creek watershed located north of Brandon in southwestern Manitoba.

The area was selected as a study watershed because the land use and wetland loss trends are representative of other agricultural watersheds across the Prairie Pothole Region of Canada. Results from the first phase determined that wetland loss since 1968 in the Broughton's Creek watershed has resulted in:

- a 31 per cent increase in area draining downstream (an additional 19 square kilometres)
- an 18 per cent increase in peak flow within the creek following rainfall
- a 30 per cent increase in stream flow
- a 31 per cent increase in nitrogen and phosphorus load from the watershed
- a 41 per cent increase in sediment loading
- the release of approximately 34,000 tonnes of carbon, equivalent to 125,000 tonnes of CO₂– the annual emissions from almost 23,200 cars
- an estimated 28 per cent decrease in annual waterfowl production

What this report suggests is that agriculture as it is presently being practiced in the Broughton Creek area of Manitoba is not only non-sustainable but self-terminating.

Around the same time the Broughton Creek report was released, David Schindler and John R. Vallentyne published a book called *The Algal Bowl: Overfertilization of the World's Freshwaters and Estuaries*. The title of the book is important in the context of what the book's famous authors want the reader to know about what is happening to our lakes and how changes that are already taking place will be exacerbated by global warming. The title is also a tribute to John R. Vallentyne who published the first edition of this book in 1974. Though he did not live to see this volume printed, the theme of his first edition persists throughout this landmark new work.

As Schindler explains in his preface, Vallentyne predicted 35 years ago that unless something was done to stop the cavalier way we are treating our lakes we would find ourselves in an Algal Bowl in the Canadian West that would be more destructive of our ecosystems and our economy than the Dust Bowl that preceded it. Unfortunately, Vallentyne's prediction has come true. Thousands of western Canadian lakes and watercourses are now suffering from varying degrees of eutrophication. This is a potentially dangerous trend.

Recommendation

We need to accelerate demonstrably successful initiatives like the *Cows and Fish* program which provides useful advice at the farm and ranch level on how to improve the health of riparian habitats and reduce nutrient loading on local streams and rivers through simple changes in agricultural practice.

Similar programs have to be expanded in rural communities, in lake-shore sub-divisions and in recreation areas.

Once again, we will not know if such programs are delivering on their promise without better monitoring of water quality; more enforcement of higher water quality standards, and further integration of agricultural policy with combined land-use regulation and water resources strategies that anticipate potential climate effects.

9. Resolving The Biofuel Issue

From 1976 to 2006 world food prices declined in real terms by about 50% allowing countries with water deficits to access virtual water at affordable or advantageous prices.

But since 2006 food prices have been rising dramatically which has created a disincentive to food import. One of the developments responsible for rising food prices is the rapid expansion of biofuel production.

Taking more and more land out of agricultural production and requiring more and more water for non-agricultural purposes will create a vicious circle of food price increases that will make it more difficult if not impossible to meet future global food production needs.

Current biofuel policy, as judged by the Forum's proceedings, was an excellent example of how to do the wrong thing with enthusiasm and of the failure to integrate public policy across linked domains of water supply, land-use policy, energy security and food production.

Recommendation

Biofuel and other energy policies cannot be developed in isolation from water supply policies or agricultural water use and practices policies. If they are, expect future conflict between sectors over water allocation.

10. Drought Preparedness

The current situation in Australia offers deep insight into the kinds of difficulties Canada will inevitably have to address in the face of the more frequent, prolonged droughts that are projected to occur on the prairies under all current climate change scenarios.

The similarities between the Murray-Darling system in Australia and the North and South Saskatchewan River basin in Canada are striking. The same number of people as rely on the Murray-Darling, about three million in three Canadian provinces, rely on the Saskatchewan for the water they need to live, to practice agricultural and to sustain industry.

Like the Murray-Darling, the Saskatchewan is considered the “bread basket” of the vast nation in which it is located. Like Australia, Canada has developed significant irrigation capacity.

If there is a real lesson for Canada it may be that in the end saving your irrigation agricultural may not be the best choice if that is the only one you make. In a perfect storm you need to save the ship you are sailing on in order to save the sailors.

Recommendation

The lesson for Canada is that the past is no longer a guide to the future. What we took for granted about our climate patterns is no longer a reliable indication of what may happen in an era defined by a warmer and therefore more energetic atmosphere.

We need to ask ourselves how we would deal with – not six years of moderate drought we experienced in the 1930s – but ten years of water scarcity followed by a drought that was half-again as severe as anything our prairie civilization has ever experienced before. And we need to be prepared as possible when that inevitable drought arrives.

11. Taking climate change seriously

On the Canadian prairies rising temperatures could quickly push our agricultural sector beyond its current capacity to adapt with devastating impacts on our regional environment and economy. Our institutional arrangements with respect to water resources management in Canada are presently as territorial and jurisdictionally fragmented as they were in Australia at the outset of the change in climatic circumstances that devastated the country’s agriculture.

Recommendation

We may wish to be proactive in the reform of our institutional arrangements so as to enhance our adaptability to climate change effects before unforeseen events make our society vulnerable to the same social and economic catastrophe that befell Australia.

12. Establishing The Right Kind of Markets

It was universally held at the Sixth Biennial Rosenberg Forum that markets and privatization can spur necessary innovation in contexts where entrenched public bureaucracy are slow and inefficient, and where entrenched interests have captured public subsidies. But it was also held that water trading markets do not always make up for lack of long term focus on water sustainability and intergenerational equity.

As water scholar Helen Ingram pointed out, water trading markets cannot make up for failures of governments. Privatization and market mechanisms cannot substitute for inept government and corrupt institutions. Well operating markets in fact depend upon a strong regulatory framework and functioning oversight. The same is true in the case of water utility privatization.

In many parts of the world where governments have been downsized, responsibility for broken water management infrastructure has downloaded to municipalities without the financial and technical resources to ensure repair, improvement and extension of urban water systems. This, of course, is an invitation to private sector involvement in municipal water supply. Such downloading, however, can only be successful over the long-term if it contributes effectively to sustainability and not just market productivity.

An important lesson Canada may wish to derive from the experience of others with respect to water markets relates to the fundamental goals of any significant water policy reform. Canadian policy-makers need to ask the same fundamental questions that continue to be asked around the increasingly water-scarce world. What is our water policy really about? Is it about market efficiency? Is it about decentralization and local participation? Or is it about sustainability? Or is it about all of these ideals?

Recommendation

The Canadian West should continue to learn from others about the best kinds of market instruments available and how they might be modified in service of our specific circumstances.

In this effort, programs such as the 2009 Alberta Water Research Institute-Alberta Water Council symposium exploring International Experience, Policy and Practice in Dealing With Water Scarcity, provide the foundation for the right kinds of choices in the future.

The Urgency of Water Governance Reform in Canada

There are real risks associated with not considering water policy reform at this point in time. Just as surely as water scarcity and decline in food production are converging toward the diminishment of the quality of human life in many other parts of the globe, it is not inconceivable the same problems could present themselves here.

Without policy reform we could very well reach a point where remediation of the damage we are doing to our own surface and groundwater water will be more expensive than we can afford, or beyond our technological capacity to address.

Without broader policy reform water quality and availability problems will very likely limit future economic and social development in part of Canada.

The failure to properly account for nature's need for water will further exacerbate water availability and quality issues making us more vulnerable to the impacts of landscape and climate change.

Without water policy reform, we risk waking up one morning to discover that we are no longer any different than the rest of the world. We will have all the same water problems our neighbours do.

What Canada needs is a new water ethic that harmonizes federal and provincial water resource management aspirations with the need to change the country's economic system so as to make true long-term sustainability possible. So why can't we create that ethic?

Why Attempts at Water Policy Reform Fail

In response to this question, the Chair of the Rosenberg International Forum on Water Policy, Dr. Henry Vaux, referred to the work of two scholars who examined the same problem in the United States.

Max Bazerman and Michael Watkins¹ believe that crises related to issues such as water availability and quality qualify as "predictable surprises" in that leaders know in advance that problems exist and that they are likely to get worse over time.

Leaders also recognize that solving the problem will be expensive both politically and economically and that the prospects of receiving credit in the short-term are very small. Every experienced politician knows that such issues are fraught with dangerous risk.

As long as the system continues to limp along, there is nothing to catalyze action. Bazerman and Watkins further report that in such circumstances there always seems to be a small vocal minority that benefits from inaction and is motivated to subvert the actions of leaders for their own benefit. And that is how good systems get run into the ground.

Fortunately no one in Canada wants to wake up in the morning with a predictable surprise on their hands. There doesn't appear to be any reason why Alberta couldn't lead Canada out of the reform rut. This may be a good time to do so for two reasons. The first reason is that options for reform exist.

¹ See *Predictable Surprises: The Disasters You Should Have Seen Coming and How To Prevent Them*, by M.H. Bazerman and M.D. Watkins, Harvard Business School, Boston, 2004.

Three Potential Avenues of Reform

There are at least three potential avenues of reform. We can revitalize the current system by activating unexercised jurisdiction and harmonizing federal, provincial and municipal oversight with respect to the management of our water resources. Revitalization of the existing system will demand improved monitoring, forecasting and prediction capacity tied to better enforcement of existing laws.

Revitalization will also demand the introduction of new regulations that protect water quality and recognize nature's need for water.

Alternatively, water policy reform in Canada could emerge from the example of others. The European Water Framework Directive is a model we may wish to examine in the Canadian context. We may even wish to apply it on a continental basis. In this framework, water quality standards and parameters of aquatic ecosystem health are defined by the European Union. Individual nations are then charged with meeting those standards by whatever means they feel will work best in local circumstances.

A third avenue of reform might be to allow regions to reform water policy on a large scale watershed basis. The Premiers of the western provinces and northern territories have created the Western Water Stewardship Council which aims to resolve potential conflicts in the management of all the river systems that have their origins in Canada's western mountains. Perhaps something similar might emerge in the St. Lawrence and Great Lakes areas and in Atlantic Canada.

Perhaps Alberta's Water for Life Strategy could be the model for a more integrated regional water policy design.

The second reason it may be a good time to press for water policy reform is that the public has begun to take an interest in water issues and may well support leaders who would press for change.

Canadians Are Ready for a Change

Early in 2009, a national Ipsos-Reid poll sponsored by Unilever and RBC explored for the second year in a row the attitudes of Canadians toward the value of our country's water resources. The poll found that Canadian concern about water has not diminished in the face of our current economic woes.

The poll also confirmed that the majority of Canadian consider water our most important natural resource; even more important to our future than oil. This is a heartening sign.

Unlike so many other places in the world, Canada still has room to move in terms of how we manage our water resources. If we can balance the water availability and quality needs of nature, agriculture and our cities, everything else we need to do to become sustainable, including addressing climate change, may very well fall into line.

Part Three: Learning From Others

There are a number of important lessons Canada can derive from what is happening elsewhere in the world:

- 1. It may be important to integrate national and regional water policy direction.**
- 2. Sustainability must be a foundation of water policy reform.**
- 3. Agriculture Everywhere Faces Similar Problems**
- 4. It is Important to Integrate Water and Agricultural Policy**
- 5. There is a Pressing Need for Improved Conflict Resolution Tools**
- 6. Basin Authorities and Councils Have a Role to Play**
- 7. There are Different Models Out There We Can Emulate**

We should look outward for solutions. One immediately wonders if it might not be worthwhile considering implementing programs in Canada similar to those undertaken by the European Union and its Member States under the aegis of the Water Framework Directive.

Certainly, if the European Union with its 27 member states and a population of 500 million people covering an area of more than 4 million square kilometres, encompassing a 23 different official languages can create a continental water framework, it is conceivable that a single 9.9 million square kilometre country with only 33 million people spread through 10 provinces and three territories with only two official languages should be able to do something comparable. We have the capacity to create a similar groundswell of change. All we have to do is want to.

Follow the Water

As offered by Dr. Peter Gleick at the close of the Rosenberg Forum in Spain there are a number of global perspectives that may be helpful in our efforts.

By way of encouraging one another toward success in dealing with the global water crisis, or the piece of it that is ours to address, we should do our best – all of us – to emphasize solutions and success stories and not just problems.

We should continue to explore ideas related to integration and methods that embrace inter-disciplinary tools.

We should be relentless in our pursuit of better ways to communicate with one another and the public.

We should do all we can to make what we know intelligible to decision-makers who will help us translate scientific research outcomes into timely, effective and durable public policy..

And whatever we do we should not lose our sense of humour or our passion for the very important work in which we are engaged.

