Converging Global Trade-offs

Weathering Climate Change
By
Following Its Effects On Water Resources

A
Presentation
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There is much discussion these days about new eco-hydrological perspectives on source water and related landscape protection and how these perspectives might serve us in addressing threats to global security such as climate change. As researchers, policy scholars and water managers around the world will understand, the entire notion of what constitutes "new" in contemporary science is highly problematic.

A great deal of very good eco-hydrological research has and continues to be undertaken around the world. Much of this science, however, goes unnoticed because there is no one to interpret it and translate its meaning and relevance into common understanding that the public can fully value and that our leaders can employ in the crafting of effective public policy. This circumstance suggests that we face the truly disturbing prospect of having all the science we need to direct us toward a sustainable and prosperous future and not achieving that goal because we are unable to put good science before decision makers in ways that will influence them.

With this in mind it may be important to examine ground-breaking perspectives that may not necessarily be that new within the scientific research context; but that have yet to realize their full potential to influence the way we might think about how we should manage our water resources now and in the future. The most valuable of these insights remain to be translated into a fuller understanding of how the hydrological cycle works in the context of where we live; how much water we might expect that cycle to supply in the future and how we might use that water to best ensure that scarcity doesn't limit global social and economic development in the future.

One significant recent global realization related to biodiversity that has yet to inform the levels at which decisions are made with respect to water resources management and land-use policy relates to how "natural" our planet's natural ecosystems actually are. Researchers in the rapidly evolving field of conservation biology are now telling us that with rapid and expansive human population growth, the end of the wild in nature is inevitable. Our species is now so numerous and ubiquitous – and our resource demands so large and diverse - that humans have now become a major influence in the process of natural selection.

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[1] The author would like to acknowledge the Rosenberg International Forum on Water Policy through which he was recently exposed to some of the world's most advanced thinking with respect to evolving eco-hydrological principles and how they might influence public policy now and in the future. The author was also honoured to be a guest of the National Academy of Sciences and the Rosenberg Forum at the Iranian – U.S. Water Forum in August, which confirmed the relevance of many of the eco-hydrological perspectives presented at the earlier forum. In connection to these opportunities, the author would like to thank the Max Bell Foundation and the University of Lethbridge who provided the means to examine how what I learned abroad might be useful within a Canadian – and particularly a Western Canadian – context.

In determining which areas we will exploit and not exploit, protect and not protect, we now choose what will survive and what will vanish. The world's remaining ecosystems are now being divided into intact systems and relic communities — which are defined as biotic assemblages that have no hope of surviving over the long term without extensive human intervention. Relic communities are composed of ghost species, plants and animals with no hope of survival unless we help them. We are now being told that from a conservation point of view the world is so diminished ecologically that we will have to let a great many relic biotic communities and ghost species vanish. There are so many, we simply don't have the resources to save them all.

With biodiversity cascading, we are cautioned now to know what we have and what it does and to anticipate what will be left when it's gone. We are told that function and not form should become the sole priority in a massive collective effort to fill in our ecological knowledge gaps in order to prepare for what will be lost.

We are told, finally, that though we are approaching the end of the wild as we knew it, it is not the end of life. Though a century of conservation effort has to a large extent failed on a global scale, we cannot give up, for what we have is still better than what could ultimately be. A degraded global ecosystem, after all, is far superior to one that has collapsed. A degraded system can still provide ecosystem services we cannot afford to provide ourselves and without which our quality of life could dramatically fall.

The implications of such widespread biodiversity decline on our water resources are presently largely unknown but we suspect that over time they could be profound. By carefully monitoring these changes, however, we will be able to better understand what we are doing to the world.

Valuing Eco-Hydrological Services

At present there are a great many benefits of biodiversity that remain external to present economic models and not yet assigned market prices, but that are nonetheless highly valued. Examples of ecosystem services that depend on healthy biodiversity include pollination, biological water filtration, detoxification and breakdown of wastes, suppression of pests and diseases, nutrient conversions, maintenance of soil cover, perpetuation of healthy wildlife populations and fish stocks.

Law makers and public policy scholars around the world are reacting to ground-breaking research that indicates that natural ecosystems may be far more important to our global economy than many of us may have appreciated. The hydro-ecological principle at the core of this insight is breathtakingly simple:

Nature has survival value to people and much of that survival value is defined by the fact that nature is our only provider of water.

In order to provide water and other critical benefits to people, nature, however, needs water, too. We need water to prime the pump – so to speak – and the hydrological cycle is a very large pump.

It follows then – and this is the important and painfully obvious part – that, if we want it to continue to receive valuable ecosystem services on a free basis, nature must be regarded in the context of water resources management decision-making as a legitimate water customer in its own right.

Current eco-hydrological research underscores much of what humans have known intuitively for generations. Healthy aquatic ecosystems contribute far more than we ever understood to the production of water through the hydrological cycle as well as to the self-purifying power of healthy wetlands, lakes, and rivers. Intact aquatic ecosystems function synergistically with neighbouring terrestrial complexes to provide regulating services such as those that control rainwater capture, enhance the storage of water in ecosystems, and facilitate the gradual release of the water that perpetuates stream flow throughout the year.

These functions in turn are responsible for the primary production of organisms that make life on Earth possible and that form the foundation of more complex ecosystems that lead to higher life forms and relationships. Together, primary production and soil formation are the basis of the biodiversity that is at the heart of the relative ecosystem stability that has defined our planet's atmospheric composition. Our atmospheric composition is in turn the foundation of the relative climate stability upon which our civilization has relied to sustain population growth and increasing economic prosperity over the past several hundred years. Natural ecosystem function is also the foundation of the ecological diversity that makes agricultural food production for our growing populations possible.

As we come to realize the importance of water's role in the stabilization of natural and agricultural ecosystems, we begin to see the ways in which our numbers may be altering the very systems upon which we depend to sustain planetary conditions as we know them. Currently, global human population growth is the highest in places where there is the least water. About 40 percent of the surface of the solid Earth receives so little precipitation that natural ecosystem function is limited by water availability. 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. That, however, is the direction in which we appear to be headed.

Storm Clouds On The Horizon

The current global water crisis has been brought about as a result of the tripling of demand over the 50 years. As Lester Brown of the Earth Policy Institute has pointed out, the drilling of millions of irrigation wells has pushed water withdrawals far beyond recharge rates in many places, in effect leading to groundwater mining. The failure to limit pumping to the sustainable yield of aquifers means that water tables are now falling in countries in which half the world's population lives; including three of the world's greatest grain producers – China, India and the United States. Since the over-pumping of aquifers is occurring in many countries simultaneously, the depletion of aquifers and resulting grain harvest reductions could come at roughly the same time. The accelerating depletion of aquifers worldwide means that this day could come about soon, creating the potential for almost unimaginable food scarcity.

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 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 has to give – and that is exactly what is happening.

We are 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.

Getting Our Global House In Order

To avoid widespread environmental cum societal collapse we have to get our global house in order. We can only get our house in order if we achieve a meaningful level of sustainability. There are at least three major problem areas that need to be addressed if we are to achieve anything close to a level of sustainability that will allow us to adapt to climate change.

The first challenge we have to address is our own perception of the seriousness of the problem. We are deluding ourselves when we think that we have the water-climate nexus in hand. We have adopted a consensus view of what we would like sustainability to mean that does not reflect reality. We think that because we can afford to engineer our way out of short-term water availability and quality issues that we are creating a sustainable water management future. There is no guarantee that this is so.

We have, over the last century, destroyed a great deal of our planet's natural aquatic ecosystem function and replaced it wherever possible or necessary with technology. Artificial technological replacements for natural and passively managed ecosystem function, however, invariably turn out to be expensive and inferior to ecosystem-provided goods and services.

From an eco-hydrological perspective at least, we are in the process nationally of turning a Taj Mahal of diverse and highly productive natural ecosystem function into a tool shed of singular engineering purpose and function. If eco-hydrology has anything to teach us it is that there are things nature does on our behalf that we don't know how and can't afford to do for ourselves.

By turning the Taj Mahal that is nature into the tool shed of engineering solutions to water quality concerns, we fail to see that in the end there won't be clean water anywhere except where we commit to water treatment. What we are effectively doing is putting nature and all of humanity on dialysis. This is something to which future generations will strenuously object.

All over the world, complex natural systems are being simplified in order to concentrate specific benefits in human hands. The cumulative effects of our global engineering efforts on our planet's life support function are becoming increasingly measurable. But this should not be taken to be 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. If anything we need solid engineering solutions more than ever. The point is that 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. But here's the kicker. We then have to reserve enough water through our management mechanisms to make sure these ecosystems have the water they need to perform these functions under current circumstances and in the altered circumstances in which we may have to live as a consequence of higher mean global temperatures.

This kind of thinking exists widely in the research community and is already emerging in some urban and regional planning departments. These perspectives are certainly present theoretically in discussions about how to merge water resources management and land-use policy – but they are not yet adequately influential on-the-ground where decision-making occurs with respect to development approvals. We need to encourage the on-going inter-disciplinary collaboration between eco-hydrology and engineering. The protection of our water resources in the face of a changing global climate gives us a damn good reason for doing so.

The second challenge we need to address relates what we must do to make room for emerging eco-hydrological considerations in the way we manage water. Until we do this we will continue to make public policy choices based on false assumptions that will have undesirable ecological, social, and political consequences in the future.

Current developments in our global market economy put into relief lessons we might learn from advanced research into eco-hydrological relations in natural systems. Unlike our economy in the last few years, nature's economy is highly self- regulated. Every component influences and therefore regulates every other. The more complex the system the greater the number of self-regulatory elements it possesses. The greater the number of contributing and regulating influences in a system, the greater the resilience of that system to extreme disruption.

Biodiversity works in service of preventing natural economies from being overwhelmed by singular events. It is because of this that life on this planet has been able to bounce back from at least five major astrophysical and geo-morphological events that threatened to wipe out almost all planetary ecosystem function in the Earth's past.

Bio-diversity-based ecosystem productivity, however, operates at its own slow pace which is often deemed too slow to satisfy human needs. In many parts of the world, hydrological cycles no longer produce enough water to meet human supply needs; and natural aquatic and terrestrial ecosystems are unable to store, purify and transport water fast enough to provide enough clean water where we want it when we need it.

To overcome these natural ecosystem limitations we have over time employed engineering solutions that aim to achieve the goal of optimizing of water supply and water quality assurance to meet our own very specific needs.

We are discovering that while they often enhance the reliability and safety of water supply, the engineering solutions upon which we rely often directly affect natural hydrological cycles and diminish beneficial natural ecosystem function. Our engineering choices also affect natural systems indirectly. It is important to remember, however, that natural and aquatic ecosystems do not exist just to supply and purify water for human use.

Natural systems perform many other functions, and when natural ecosystems are diminished or disappear these functions have to be reproduced or enhanced elsewhere if our planetary life-support system is to continuing functioning in the manner in which we have come to rely. If eco-hydrological research tells us anything it is that that is clearly not happening.

The third big challenge we face relates to governance. There are many prominent scientists and public policy scholars around the world that fear that our environmental problems could get away on us simply because we failed to build a strong enough bridge between science and public policy. If we are to achieve anything resembling long term sustainability science needs to find better ways to give decision-makers the perspectives and language they need to craft durable public policy options in a timely and effective manner. It is not just local issues to which policy makers must be attuned. We also have to provide political leaders at all levels the perspectives they need to act upon knowledge about what is happening elsewhere that may affect them in their unique local context.

Very real problems exist globally associated with jurisdictional fragmentation, weak regulatory strictures and the absence of proper monitoring. There is a growing sense in some influential quarters that our global water management problems will go away if we simply let the marketplace do its magic. While one cannot object to markets as a means for managing increasingly scarce water resources, we know from international example that even carefully developed water markets cannot make up for failures of government to offer appropriate oversight that can only emerge through strong regulatory frameworks.

As we have seen abundantly recently in the United States, the market serves itself first and does not serve the common good unless government demands that it do so. Any government that argues otherwise deserves to be challenged by the citizens that elected it for failure of duty and care.

In trying to confront well-identified future challenges such as sectoral and regional conflicts over shrinking water supplies, increased demand related to growth and development, climate change, and demands for water from new energy developments such as biofuels, we need to aim for far more than just market efficiency.

As University of Arizona water scholar Helen Ingram has written, before we contemplate the need for better water policy on a global basis we must ask ourselves some fundamental questions. What is our water policy really about? Is it about market efficiency? Is it about decentralization and local participation in water resource decision-making? Or is it about sustainability? Or should it be about all of these things together?

Global example warns us that achieving part of the goal is not enough. Examples from elsewhere also suggest that regardless of the party in power, only very strong governments committed to achieving all of these goals and not just one end of the spectrum will be able to implement a comprehensive program of policy transition capable of achieving anything close to long-term sustainability. Examples elsewhere suggest that with cooperation, multiple water management goals can be achieved.

What we need is a new global water ethic encourages harmonization of regional, national and local water resource management aspirations. Under the aegis of that ethic we need to ensure formal representation for the environment itself and ways to advocate for nature's own need for water so as to perpetuate bio-diversity based ecosystem productivity central to long term perpetuation of favourable to hydrological circumstances where populations are concentrated around the world.

If we can balance the water availability and quality needs of nature, agriculture, and our cities, many other things we need to do, including achieving sustainability and addressing climate change, may very well fall into line.

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He has authored some 20 books on the natural and human history of the Canadian West, as well as two recent books on water issues in Canada.