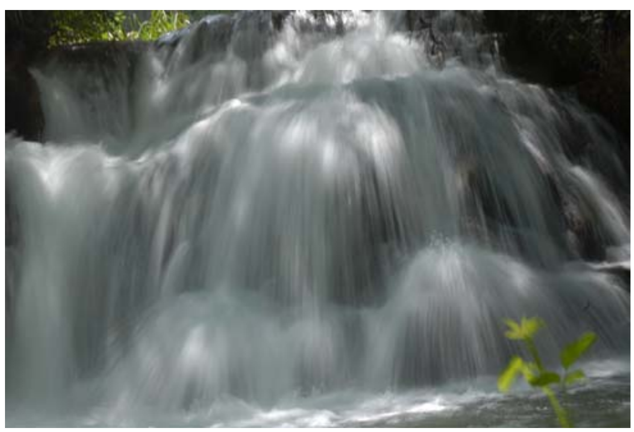
Converging Global Food & Water Trade-offs

International Lessons Derived From the Rosenberg International Forum on Water Policy

Zaragoza, Spain
June 24 – 27, 2008



A Report for the Max Bell Foundation

Prepared By
R.W. Sandford

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 after the forum and may have varying views on its significance in the context of their own work and situations.

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 wide ranging issues the forum examined.

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 and discussions that took place at pre- and post-forum events is available through the author at sandford@telusplanet.net.

The author wishes to acknowledge the support of the Max Bell Foundation in Canada and the University of Lethbridge for making this rich analysis possible.

RW Sandford

Bob Sandford
Chair
Canadian Partnership Initiative
United Nations
Water for Life Decade
&
Advisory Board Member
Rosenberg International Forum
On Water Policy

Converging Global Food & Water Trade-offs

Water for Food in a Changing World

The Global Fresh Water Supply Picture Is Not Rosy

An understanding of the current state of our civilization can be derived from the condition of the planet's fresh water resources. In developing countries – where the bulk of the population of the world lives - more than 90% of all sewage and 70% of industrial wastewater is dumped untreated into surface water.

Even if we were able to keep it clean, however, there is not enough water globally for all the things humans need and want water to do for us. Water supply bubbles are bursting in China, the Middle East and India with potentially serious implications for the global economy and for political stability. Even the United States is depleting groundwater on average 25% faster than it is being replenished.

Our thirst for water grows with our population, but the amount of fresh water available on Earth is fixed. If we assume "business as usual" by 2050 about 40% of the projected global population of 9.4 billion is expected to be facing water stress or scarcity.

With increasing climate variability being predicted by global climate models, we are likely also to have more people without adequate water more of the time, even in water rich regions.

The Amount of Water We Have Will Limit the Amount of Food We Can Grow

Abundant water is not only essential to the photosynthetic process by which plants manufacture the carbohydrates that are the foundation of our food supply, it is also an important structural element in our food products. There is a lot of water in the food we consume. It has been estimated that we eat 70 times more water than we drink. World water demand is directly influenced how many of us there are and what we want to eat.

Increasingly, the response to global water scarcity will not by 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.

Unfortunately, there are now so many of us, and our dietary expectations have risen so dramatically in the past fifty years, that we are approaching the limits of the water available to grow all the food we want. We should not worry just about running out of oil. We may not make it to the projected global population of 9.4 billion by 2050. There may not be enough water.

Cities are Now Competing with Agriculture and Nature for Water

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.

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 functions central to the maintenance of our planetary life-support system.

Humanity is Converging upon the Need Globally to Make Uncommonly Difficult Public Policy Trade-offs

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. These are trade-offs that have never had to be made on a global scale before.

We are already putting a great deal of faith globally in a stressed and demonstratively non-sustainable agriculture. 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.

Our hope of preventing the convergence of these dangerous circumstances has resided in our faith in innovation, science and technology. But in the dry regions of the world such as the Middle East, Africa, Spain and Mexico – and in new regions made permanently drought-prone such as Australia and parts of the American West engineering and technology have only been successful in creating short-term stop-gap solutions that often lead to greater ultimate vulnerability as populations continue to grow and material expectations rise.

Confronting Nature's Need for Water

Irrigation productivity rose dramatically over the past 40 years as a result of the Green Revolution. But, even if we disregard the environmental impacts caused by that revolution, we are no nearer to achieving global food security than we were 40 years ago because every time we come close to filling the food production gap population growth and ecosystem decline associated with water diversions to human purposes set us back. Our natural and agricultural ecosystems are trying to tell us something.

Recent ground-breaking research reported by Uriel Safriel in his Rosenberg Forum paper, indicates that natural ecosystems may be far more important to our global economy by way of water supply 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.

From this it becomes clear 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. But in many places it isn't.

Taking Nature's Need for Water Seriously as a Means for Making More Water Available for People

A recent study of the estimated value of 17 ecosystem services provided by 16 worldwide ecosystem types was estimated at an average of US$ 33 trillion a year which is nearly twice the global gross national product which is currently estimated at $18 trillion per year.

It is interesting to note that the highest value of ecosystem service provided by nature was nutrient cycling. The overall planetary value of nutrient cycling was estimated at about $17 trillion a year, nearly half of the total value of all the services provided free to us by our planet's functioning ecosystems. Nutrient cycling is largely a service provided by water.

From this it becomes evident that, while all services are essential, water-regulating functions are more valuable than other regulating services. While one might not agree with the value attached to these services or even with dollar accounting for what nature does in service of making life on this planet possible, an important point is put into relief through this kind of audit.

Despite their small area globally, aquatic ecosystems are found to be of extraordinary actual and relative value. Coastal estuaries were deemed the most productive of all freshwater ecosystems followed by inland wetlands. More striking, perhaps, is the comparative value of global freshwater ecosystems to terrestrial ecosystems.

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.

While all freshwater ecosystems together comprise on 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.

Natural ecosystem function is also the foundation of the ecological diversity that makes agricultural food production for our growing populations possible. But natural systems are not the only ones capable of contributing to planetary life-support function. To a lesser but not unimportant extent, human-altered systems can do this, too.

Researchers in the Middle East have demonstrated that managing natural and human-altered ecosystems in tandem can create more water for both people and nature.

In Israel in 1993, scientists calculated that the potential water yield of that country's natural Mediterranean scrubland – that is to say the volume of rain falling during a given year on a given surface minus the volume of water returned to the atmosphere from the same area in the same year – is about 1590 cubic kilometres a year.

In little more than a decade scientists experimenting with diverse arrays of agricultural plant species were able to increase the potential water yield of this region by some 16% to 1846 cubic kilometres a year by transforming it into an optimally diverse cultivated ecosystem.

This improvement was accomplished by enhancing the water provision function of the "natural" Mediterranean scrubland ecosystem so as to reduce the amount of soil moisture that was evaporating. This demonstrates that human landscape transformations undertaken with the aim of enhancing the water regulation function of a given ecosystem can result in increased soil water content being available for both agriculture and nature.

The great breakthrough here is that millennium definitions of "ecosystem" include both cultivated and urban ecosystems. Agricultural and urban ecosystems suddenly become part of a global ecological whole.

The new construct recognizes that actively managed ecosystems now constitute more than half of the ice-free Earth, and that 11% of these are cultivated. It recognizes that it is not just pristine ecosystems that provide marketable goods and generate priceless services such as water purification, aquifer recharge, soil development and – until recently – relative climatic stability.

Beyond Engineering: An Eco-Hydrological Frontier

It is important to pay attention to the fact that natural systems perform many functions, and when natural ecosystems are diminished or disappear these functions must be reproduced or enhanced elsewhere if our planetary life-support system is to continue 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.

Historically, it has been a given that when humans impair the provision of goods and services by either natural or passively managed ecosystems these must be replaced by artificial means. What we have discovered, however, is that artificial technology replacements for naturally or passively managed ecosystem function invariably turn out to be expensive and inferior to goods and services provided by "natural" ecosystem function. This is a fact we need to explore if we want to solve the global water availability problem.

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.

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. If anything we need solid engineering solutions more than ever. But we do need to know more about how urban and agricultural ecosystems can 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 together 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. We may not be able to do this if our population continues to mock our every technological advance and undermine our best efforts to achieve sustainability.

What we learn from these examples is that while engineering and technological innovation will always be important, the area in which we may need to concentrate most in the management of our water resources is on sustainability of use which suggests our central focus should be on governance for it is in this broad and universal domain that our collective ineffectiveness is likely to produce the greatest potential for conflict which can only occur at the cost of achieving sustainability in the future.

Failures of Governance

As many water policy scholars have pointed out, there are many exciting new ideas in the field of water management but we unfortunately failing to act upon them. This failure takes a number of forms.

Shortcomings in contemporary water politics globally are marked by the failure to properly contextualize water issues in ways that take into account local history, culture and relationship to place. This is in part least connected to an unwillingness to address deep-seated inequities in the way water is allocated and managed in many places in the world.

This unwillingness to address equity injustices makes it difficult to frame issues in ways that will attract and sustain public attention which in turn makes it difficult to recruit and inspire leaders capable of the sustained effort required to bring about long-term water policy reform.

Without forceful leadership it is impossible to create, foster and cultivate the level of political will over the duration of time required to ensure proper and lasting implementation of improved policy leading to changed practices and different results.

What is needed is a new global water ethic. That ethic could have its origins in the first principles that define the relationship between ecosystems and water supply.

Solutions Exist:
We Need To Know Why We Don't Implement Them

As a society we are painting ourselves into a difficult corner. There are too many of us and our diverse business and religious traditions and a fear of being overwhelmed by culturally different others will not permit us to reduce our numbers. Our agriculture and resource needs have become so substantial that they are shutting down other life-support processes upon which the entire global system depends for stability and sustainability.

We can see clearly what is happening but we can't do anything in part because no one wants to be the first to make compromises or sacrifices for fear that those who won't make those same sacrifices will triumph over them economically or politically.

If there was ever an area of social science research that needs urgent attention it is the form of environmental *cum* economic brinksmanship we practice that ignores the obvious impacts of rapid population growth, encourages agricultural practices globally that we know are non-sustainable, acknowledges that biodiversity losses are compromising the state of our global life-support systems and yet takes only token steps toward preventing such loss; and knowingly starves nature of the water it needs to provide services to people that we cannot afford or do not know how to supply for ourselves.

The social science research we need to undertake must explore elements of our nature that would allow us to make apparently rational choices that support the constant pushing of every environmental constraint and limit until the system breaks down and has to be replaced by costly but ultimately inferior artificial solutions that we in turn push to the limits of failure through relentless population and economic growth.

As water resources expert Margaret Catley-Carlson pointed out, we focus too much on what should be done and not enough on why it isn't done. As a civilization, it may be a good time to look in the mirror. We should not just look at ourselves but at what is coming up fast behind us in the form of converging problems that together may be more difficult to address than we can imagine or afford. Global economic analysis indicates that the greatest new scarcity to appear in our time relates to limitations on the environment's capacity to absorb and neutralize the unprecedented waste streams humanity looses upon it. Nature is not likely to turn against us, but we are turning nature into might.

What Are The Solutions?

In his synthesis of the outcomes of the Sixth Biennial Rosenberg International Forum on Water Policy in Zaragoza, Spain, renowned water resources expert Peter Gleick identified five avenues of potential public policy advancement that will serve humanity in our efforts to address the current global water crisis.

1.
Ignore Ideology; Expand Thinking

Gleick offered firstly that while ideological debates were often interesting and even enjoyable, they are not necessarily productive. The kinds of ideological debates he put into this category included arguments over infrastructure; the debate pitting markets and privatization against water as a human right; and the debate over whether or not genetically modified organisms should be accepted as part of the future of agriculture.

Given how advanced the water crisis has become - we may no longer have the luxury of debating such matters. What is important now is to expand our thinking rather than contracting it around unproductive wrangling.

We need to realize how easy it is to get technologies right but the institutions wrong. It is also important to realize that what might work in one place, for small landholders in Africa for example, may look different from solutions that may work in larger-scale systems, say in Asia.

But what is really important at this time is to challenge some of our most cherished assumptions. These include the stationarity of climate and water availability and our deep-rooted belief in singular, silver bullet solutions.

2.
Integrate; Do Not Isolate

There is an urgent need for less isolation in the evolution of water resources policy. While there are examples from around the world of where undue focus on only one element or benefit has resulted in damage to entire hydrological systems the most compelling example of public policy failure in this area is the current biofuel issue and its impact on global food prices.

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 is widely seen as an excellent example of how to do the wrong thing with enthusiasm not because of its intentions, but because of its failure to integrate public policy across linked domains of water supply, land-use policy, energy security and food production. Future biofuel policy has to respond to these linked domains.

Isolated public policy failures become apparent where increased water use in one sector traditionally comes at the expense of other users and especially the environment. We have also learned at great expense that it is unwise to permit any activity that leads to groundwater pollution or increased salinity. Such impacts make it impossible to use water for any other purpose than the one that led to its contamination.

We can see now that the isolated goals of many 20th century water projects focused on a narrow set of benefits which, when realized, made other potential benefits impossible to achieve. Hydropower, flood protection, irrigation and recreation projects ultimately serve isolated functions if they do not integrate impacts on ecosystems, local communities and local cultures into the way they are designed and operated.

Water resources policy has to integrate the widest range of purposes and interests into evolving management approaches including an acceptance of nature's equal right to water to perpetuate ecosystem function.

Broader integration of water solutions must also mean embracing expanded conceptions of international trade such as those implicit in notions related to virtual water export in the form of food.

3.
Innovate

We need to explore new ways of thinking about the water we use and need. We shouldn't just think about the "blue" water that flows in streams and rivers. We should think about the "green" water that falls as precipitation, is absorbed into the soil and evaporated from the earth and evapo-transpired through plants as a second vital and almost untapped water resource.

The management of these two water sources in tandem will allow further expansion of our global food production capacity while at the same time allowing more water to be reliably available for a variety of environmental requirements including in-stream aquatic ecosystem flow needs.

Innovation means using the concept of virtual water as a planning tool. Innovation also means the continuing evaluation of "non-traditional" water sources such as rainwater harvesting, conjunctive use of groundwater, treated wastewater and desalination, even in places that were once seen as possessing relatively abundant water supply.

Innovation also means rethinking water "demand". It means moving away from the idea of "using" water toward the idea of optimizing "benefits" that water provides. Significant innovation is required in areas such as improving yields while reducing water use per unit of production.

Innovation also means rethinking water "institutions" and "management" and the need to bring the natural sciences, social sciences, politics and water more effectively together.

4.
Improve Information

By far the most urgently needed science relates to improving our ability to cope with seasonal water scarcity.

Agricultural researchers around the world are arguing that with all of the investments made recently in climate change-related research it should not be unreasonable to expect far more reliable seasonal water availability predictions.

It was also noted that while more and more voices in the water-stressed world are calling for improved seasonal water availability forecasts, 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.

In the end, improvements in monitoring and remote sensing necessary for future improvements in water productivity are not going to be achieved by simply influencing the growing environment.

Scientists need to communicate better with policy-makers just as policy-makers have to communicate far better with scientists. And everybody has to communicate better with the public. We cannot ignore the urgency of effective action.

5.
Initiate and Implement

We may wish to order our water resources policy priorities in the following way:

- Meet the needs of the poorest, but especially of Africa
- Don't ignore the population growth issue and the growing number of problems converging around the challenge of feeding more and more people at the expense of the planet's ecosystems.
- Continue to strive toward higher water efficiency and productivity
- Continue to focus on investment in improved technology and practices
- Continue also to improve governance and management

Successful solutions to water problems are available and being implemented every day. We should build on successes and learn from our failures.

The most successful solutions in the future will be those that move beyond ideology; integrate concepts; communicate new information in new ways; and that lead to action.

So, In Conclusion

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

ROSENBERG INTERNATIONAL FORUM ON WATER POLICY