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Future of Water for Food: Policy and Human Dimensions Panel

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An aerial photograph of a dry, cracked riverbed. The riverbed is composed of light brown sand and silt, with numerous small, irregular cracks and pools of water scattered throughout. Patches of green grass and moss are visible along the edges of the dry riverbed. A solid blue horizontal bar with a subtle bubble pattern runs across the top of the image.

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The Cost of Water

Policy and Human Dimensions Panel

Panelists

Marc Andreini, *Senior Researcher, International Water Management Institute*

Sandra L. Postel, *Director, Global Water Policy Project*

Otto Szolosi, *Irrigation Consultant and Former Lecturer, Charles Sturt University, Australia*

A. Dan Tarlock, *Distinguished Professor of Law, Chicago-Kent College of Law*

Sandra Zellmer, *Professor, University of Nebraska College of Law*

Moderator

John Owens, *Harlan Vice Chancellor for the Institute of Agriculture and Natural Resources, University of Nebraska–Lincoln, and Vice President for Agriculture and Natural Resources, University of Nebraska*

The panel discussion focused on the effects of water and agricultural policies on freshwater supplies, food production and security, the environment and the socioeconomic well-being of people at global, regional and local scales. Among the panelists were two lawyers, a civil engineer and an agricultural engineer, all of whom brought extensive experience in the field of global water management. The panelists gave brief overviews of their subject areas and then responded to questions from the audience.

Marc Andreini: The Biophysical Environment, Infrastructure and the Process of Policy Reform

Marc Andreini is a civil engineer and senior researcher at the International Water Management Institute with extensive experience in management and water supply projects in California and many African countries, including Ghana, Zimbabwe, Morocco, Tanzania and Botswana.

“Africa is a very heterogeneous place and it has enormous potential,” Andreini said. “So what are we going to do? Water is clearly central, and Africans should make good use of the water that they have. We need to make science-based decisions.” He highlighted three areas of focus: the biophysical environment, particularly the meteorology and hydrology of Africa; the infrastructure choices to be made; and the process of institutional and policy reform.

Biophysical environment. Although the colonial regimes did some environmental monitoring, these efforts mostly have a sketchy past, so the infrastructure to collect meteorological and hydrological data needs to be re-established. Africa needs an established monitoring network and groundwater research. To date, the information on groundwater in Africa is unreliable, fragmented and only available in certain European archives. In parallel, assessments using remote sensing techniques and geographic information systems also need to be established to understand current developments. Models to answer water allocation questions must be developed at international, national, regional and local scales. Andreini emphasized that to address conflicts, it is important to establish policies that provide equitable access to water at the local level.

Infrastructure: Water storage facilities. The lack of water storage facilities in Africa is critical. The U.S. has 6,000 cubic meters of storage per capita; South Africa has 750; and Ethiopia has only seven. Climate change is making the rainfall season shorter and the onset of the rainy season more erratic, further increasing the need for storage. Although dams are controversial, Andreini believes there is increasing interest in building medium and large dams. If Africa does this, it must be careful to develop well-designed projects that avoid the mistakes of the past. Andreini also advocated for increasing small reservoirs managed as a common property resource at a community scale. Finally, Andreini said, the sustainable and equitable use of groundwater reservoirs needs to be actively explored.

Institutional and policy reform. “We need input from the social scientists. We need to know how the institutions and economic reforms that are to be made can be as meaningful as possible,” Andreini said. Greater regional integration must enable producers and sellers to buy and sell from one another across regions, provide greater access to markets and allow producers to buy inputs, such as pumping technology, fertilizer and seeds. This effort also involves making smart choices about transportation infrastructure, such as where to build roads.

Sandra L. Postel: A New Mindset for the Agricultural Water Economy

Sandra Postel is director of the Global Water Policy project, dedicated to the preservation and sustainable use of Earth’s freshwater ecosystems. Postel is a respected scholar and author on science and policy related to water and the environment, including the books “Pillar of Sand: Can the Irrigation Miracle Last?” and “Last Oasis: Facing Water Scarcity,” which appears in eight different languages and was the basis of a 1997 PBS documentary.

Postel said as she listened to the previous speakers, she was reminded of Albert Einstein saying a problem can’t be solved with the same mindset that created the problem. “We really are talking about a new mindset if we’re thinking about water and food and the whole nexus of water and poverty and environment and energy and agriculture that’s come up time and again,” Postel said. She then identified five themes to guide the discussion on developing a Global Water for Food Institute.

Sustainability of irrigated agriculture. Eighteen percent of the total acreage of arable land and tree crops on the world’s continents is irrigated and produces 40 percent of the world’s food. However, perhaps as much as half of this irrigation is not sustainable, Postel said. Groundwater is being over-pumped, rivers are running dry and soils are becoming salinized. Experts estimate that as much as 10 percent of the current food supply depends on groundwater, and in India, this number may be as high as 20 to 25 percent. Postel said it seems fairly certain that China, India and Pakistan – countries that were self-sufficient until recently – soon may need to import grain. Pakistan alone may need as much as 12 billion tons of grain by 2013. This will significantly impact the international grain trade and international food prices. Some of those changes will be positive for farmers, but they will burden the hungry people in Sub-Saharan Africa. Policymakers need to understand and prepare to deal with these impacts. The sustainability of irrigated agriculture has related technological, social, economic and policy components that must be considered. “We’ve heard that technologies can be developed, but if they’re not going



Marc Andreini

to be adopted, they're not going to do any good, so I think embedding these together is critically important if we take on that challenge," Postel said.



From left: Dan Tarlock, Sandra Postel, Marc Andreini

Climate change. "If we're going to be talking about food production and sustainability 20, 30, 40 years out, we've got to start getting our heads ... wrapped around the magnitude of these changes," Postel said. Two billion people in south Asia depend on rivers fed by glaciers that are shrinking, and those water supplies will largely be gone within our planning period. At the same time, mountain snow packs are diminishing and changing river flow patterns, already evident in California. There will be more flooding in the spring and more dry spells that increase the competition for water during the summer when water is needed for crops.

Protecting ecosystem services. Postel discussed the need to value and protect ecosystem services. Agriculture, she said, happens in a landscape that provides important, intrinsic ecological goods and services. These ecosystem

services consist of moving nutrients and sediments downstream to deltas, restoring productivity to flood plains, maintaining biodiversity and improving fish production. Though not largely valued in the marketplace, these measures are extremely valuable, particularly, but not exclusively, to subsistence dwellers in developing countries. According to Postel, a significant policy trend is underway to protect ecosystem health and ecosystem services. She said South Africa blazed this trail with its 1998 water act, which established the progressive concept of a water reserve. It has two components: the basic human needs reserve, which provides essential water for drinking, food preparation and personal hygiene, and the ecological reserve, which protects aquatic ecosystems. The European Union now has a water directive requiring all rivers to achieve at least a good status by 2015, and the recent Great Lakes contract in the U.S. basically prohibits big diversions from the lakes. These are concrete ways in which this concept of protecting ecosystem health and ecosystem services is being adopted. Water use, water allocation and water management must be integrated with this new goal of preserving ecosystem health and ecosystem services, Postel said.

“Water use, water allocation and water management must be integrated with this new goal of preserving ecosystem health and ecosystem services.”



Developing and using appropriate technologies. "All of these things suggest to me we need to be moving toward a fairly tangible goal of at least doubling water productivity in agriculture over the next 15, 20 years, and I say that 'doubling' in a fairly broad sense," Postel said. That includes not just more crop per drop but also more nutritional value per drop. Designing technology that is affordable and accessible to the poorest farmers is key. One example is the treadle pump, a \$35 investment that returns a hundred dollars in the first season for poor farmers living on a dollar or two a day. This technology has tremendous potential to lift large numbers of people out of poverty. Expansion of drip irrigation is another way to move toward this goal. Drip irrigation could be used with most crops, but only 1 percent of the world's irrigated land is under drip.

Changing diets and increased food demand. Postel spoke about the need to consider the increased water demands caused by the world's changing dietary demands. In China, 300

million people have moved into the middle class and are adopting diets more like those in the U.S., a trend that will increase. “Beginning to deal in a conscious way with the water footprint of our diets is going to be an important feature of achieving some kind of sustainability in water and food production,” Postel said.

Sandra Zellmer: A New Era in Water Law

Sandra Zellmer’s expertise is in water law, environmental law and ethics, and natural resources law. She recently served on the National Academy of Sciences National Research Council Committee on Missouri River Recovery, examining the impact of flood control measures and habitat restoration efforts from the river’s headwaters to the Gulf of Mexico.

Zellmer quoted poet Thomas Hornsby Ferrell: “Here’s a land where life is written in water,” saying those words are as true today as when they were written in 1940, following the Dust Bowl years in the Great Plains. She also quoted Mark Twain, who said, “Hunger is the handmaid of genius.” Likewise, Zellmer added, thirst is the handmaid, or perhaps the mother, of invention and innovation in water management. People have figured out how to store water behind massive dams, move water over hundreds of miles and over the Rocky Mountains, to purify and reuse polluted waters and even reverse the flow of some waters. Yet states continue to fight over who gets the water, how much they get and how it should be used. “This tells us – and this is what Ron Yoder and others have noted today – that we’ve done pretty darn well on the technology side of water management. ... But I have to say we’ve done relatively poorly on the institutional side, governance, law and policy,” Zellmer said.



Sandra Zellmer

How natural resources are allocated. Essentially, Zellmer explained, there are four basic ways to allocate natural resources:

- Eligibility criteria, such as geographic location on the headwaters of the stream, or preferences for various types of use, like domestic use;
- First come, first served, the rule of capture – the first one to use the water in an economically productive way develops a legally recognized right to the water;
- A more random access approach, such as government-sponsored lotteries, like those used to allocate sulfur dioxide emissions and other emissions credits; and
- Economic tools such as auctions and cap-and-trade.

Some basic concepts of water law. In the 19th century in arid areas of the western U.S., people developed the concept that someone can use water on non-riparian lands away from the stream. This was a departure from the rules used to manage water in many other areas of the world. Another concept adopted in the West is the law of prior appropriation: first in time, first in right. As long as the use is beneficial and non-wasteful, senior users can take their full allocation of water even if more economically viable or environmentally valuable junior users have to go without. This system provides certainty, which protects investments and reasonable expectations. Seniority is important because in most of the West, and certainly in Nebraska, agricultural users hold the most senior water rights.

“The fundamental goal to ensure everyone has access to a clean, reliable water supply to satisfy fundamental human needs, including the need for food, has not changed.”

In contrast, when water bodies cross state or international boundaries, water allocation is governed by the principle of equitable apportionment, reflecting the two bedrock principles of modern international environmental law. The first is that no nation has the right to use its territory in a manner that causes injury to the territory of another. The second is that trans-boundary waters should be shared equitably among riparians, so each may enjoy a fair share. In international law the determination of fair share is guided by factors including the natural physical factors; the geographic, hydrological, climatic and ecological features; the social and economic needs; the effects of water use by one nation or state on another; and the conservation and protection of the water resources.

Sustainable development. Equitable apportionment, in turn, is becoming an important part of sustainable development. Using the definition from the United Nations Agenda 21, Zellmer said sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Zellmer described three fundamental concepts from Agenda 21 relating to water: (1) providing adequate water supplies; (2) maintaining the ecological services that provide goods and services for human communities and ecological communities; and (3) recognizing capacity limits, or carrying capacity.

Points of distinctions and convergence. Zellmer also described how the myriad systems of water law throughout the world reflect deep distinctions as well as points of convergence. The convergence points are greater reliance on science and integrated management, such as the conjunctive management of surface and groundwater resources, and drawing on the physical and social sciences to learn how to most efficiently and equitably engage in conjunctive management. Another point of convergence is a greater reliance on expert administrative agencies, such as the U.S. Environmental Protection Agency or, in Nebraska, the state Department of Natural Resources. This means less reliance on courts, the judiciary or legislatures because of the recognition that people with technological expertise are needed to resolve some of these scientifically driven questions.

One distinction is a conflict and continuing tension in international water laws between centralizing policies at the higher levels of government and a movement for greater grassroots initiatives and local watershed governance with transparency, accountability and implementation of legal principles. Zellmer said there also is a struggle between privatization and the use of market-based tools to allocate water resources and the vision of water as a common heritage, a public trust resource or even a human right.

A new era in water law. Water law in the U.S. and throughout the world is on the brink of a new era, Zellmer said. Growing populations, growing energy demands and climate change will put increased pressures on water resources. The fundamental goal to ensure everyone has access to a clean, reliable water supply to satisfy fundamental human needs, including the need for food, has not changed. But as Agenda 21 recognizes, new stresses will make innovative, collaborative and integrated approaches to water management all the more imperative. “You might say, make whiskey, not war, or more drinking, less fighting,” Zellmer said.

A. Dan Tarlock: From Dams to Integrated Water Management

Dan Tarlock's interests focus on aquatic ecosystem conservation, water transfers, climate change and drought management. He has served on several National Research Council/ National Academy of Sciences committees studying the protection and recovery of stressed aquatic ecosystems.

Tarlock expressed his enthusiasm for the University of Nebraska establishing a Global Water for Food Institute, saying that although the U.S. has accumulated great expertise in water over the last two decades, it hasn't been as aggressive as it should be, or as many northern European nations have been, in applying this knowledge overseas.

The question of large dams. Tarlock focused on the evolving international law of water use and management as it relates to dams. As a young lawyer in the 1960s, Tarlock thought his career would be guided by two bedrock assumptions. First, the construction of large multiple purpose dam projects would continue; and second, irrigated agriculture in the U.S. would continue to expand. The environmental movement ended the big dam era, and today there is almost no expansion of irrigated agriculture in the U.S.. Globally, the appropriateness of the large dams and irrigation systems is often debated, although philosophies are generally more lenient in developing countries.

Integrated water resources management. Traditionally, Tarlock said, international water law had one primary objective: to support the construction of big dams. It did so because the law was so incoherent it encouraged unilateral action. Over time the international community has tried to develop a system to constrain unilateral dam construction and to encourage more cooperative, integrated river management to balance a wider range of uses. Tarlock presented two examples of emerging river regimes where integrated water resources management and a richer management system have been taken seriously.

The Okavango River in southwest Africa has the classic conflicts. The river arises in Angola, but its development potential is unrealized because of the civil war and the Portuguese colonial legacy. The river flows through the top of Namibia, which is largely a desert except for the greener north. There is pressure to bring Okavango River water down into the drier center of Namibia. Downstream from Namibia in Botswana, the river forms the Okavango Delta, which supports a variety of ecosystem services and a well-funded, premier world wildlife area. Finally, the Okavango flows into a swamp in the Kalahari Desert known as the Okavango alluvial fan. The three countries along the Okavango River have developed a cooperative management institution that focuses on collecting data to understand the river. The institution is a work in progress, but, in Tarlock's view, has put the brakes on unilateral development; any development along the river must balance the interests of the three countries.

The Komati River arises in South Africa, flows through Swaziland and empties into the sea in Mozambique. Although the river has a very erratic flow, with periods of drought



Dan Tarlock

and high floods, it supports agriculture in all three countries. Sub-catchment flow targets have been established, but the consensus is that if irrigated agriculture is going to expand, or even be maintained, the countries must find a way to maintain the flow regime.

Two major problems will have to be addressed. The bottom line, Tarlock said, is that any effort to promote increased irrigation or even greater water use will face two problems. First, the new legal constraints, if only because the Dutch, Germans, Swedes, Danes and the British, who fund many of these efforts in developing nations, are going to require integrated water management. New laws will have to be adopted. “And, of course, there is going to be a whole host of new uncertainties. Global climate change is only one, so what you’re going to have to see is a greater flexibility in management institutions,” Tarlock said. Water resources development is going to be a lot smarter, and the scale of development will be smaller, partly driven by the new legal environment.

Otto Szolosi: Australian Water Issues and Policies

Otto Szolosi is a water management, irrigation, drainage and erosion control consultant who has participated in large-scale water reuse, wastewater and irrigation projects.

“Coming from Australia, I can assure you that water is a limited resource and that the whole country across the six states is facing major challenges in assuring a sustainable water supply,” Szolosi said. “Seeing the water levels dropping in our storages ... is scary, really scary.”



Otto Szolosi

No water to waste. Today and in the future, Szolosi said, the combination of climate change and a growing world demand for water means there simply isn’t any water to waste. The water in storage for Melbourne, a city with 3.8 million residents, is at 27.6 percent of storage capacity. All the major cities in Australia are under water restrictions. New houses must have three pipes, for fresh water, domestic waste and reuse of the shower and laundry water. In 2002, the average water usage was around 330 liters per person per day. Today the target is 155 liters per person per day, and in April Melbourne achieved 135 gallons per person per day. Most households also have a four-minute shower timer. The more water a household uses, the more it pays.

Many speakers have described a variety of technologies that will allow increased crop production with less water, but the implementation of these tools and the management of water resources, including the legal and the institutional issues, require much more attention around the world, Szolosi said. Ten years ago, Australians didn’t comprehend the extent of the country’s water shortage; many said it was a water management issue and an institutional and legal problem. With the continuing drought due to climate change, most Australians now agree that the water shortage is one of the country’s biggest challenges.

Australia's water issues. Szolosi cited the following water issues:

- Over-allocation by state and territorial governments wastes water.
- Water is used by the private sector, but water administration is predominantly in public hands.
- The need for adaptive management of a highly variable resource contrasts with the need for entitlement security for those invested in production.
- There is disparity of water management practices and the emerging competition between the urban and rural sectors.
- The need for skill in planning for catchment water management conflicts with centralized policy setting regulations.
- The country has problems with water supply and aging infrastructure systems.
- The government limits current water allocations.

Australia's Water for the Future Initiative. In 2004, in response to the above issues, the Australian government launched the Water for the Future Initiative, a 10-year, \$12.9 billion plan that provided national leadership in water reform to secure supplies for Australian households, businesses and farmers, and to allocate water to restore the health of Australia's stressed river systems. The initiative has four priorities: taking action on climate change, using water wisely, securing water supplies and supporting healthy rivers. Its programs have accelerated on the ground actions in these areas.

Policymakers have had to acknowledge the impracticability of continuing to supply water at a low cost and the urgent need to address policy issues in water resource management. The country has begun to focus on water resource management through legislative and institutional change, attempting to allocate water in a more economically efficient and socially and environmentally acceptable manner.

Water trading, a major achievement of the initiative, is creating open and competitive markets where water use is managed rather than administrated by governments. It is yielding significant economic and efficiency benefits. The price of a temporary water right ranges from \$200 to \$1,200 per megaliter (1,000 cubic meters). When water trading began, the price was between \$60 and \$150 per megaliter; in the 2008 irrigation season, the average price for a temporary water permit was \$1,066 per megaliter, and permanent water permits were trading at \$976 per megaliter.

What has this initiative achieved after nearly five years? According to Szolosi, Australia has an increased focus on adaptively managing water resources for economic and environmental purposes, securing water access entitlements for users, expanding water markets and introducing more effective prices and policies. Australia's users across the board are improving their practices.

Will the changes meet the reform objectives? An expanded market that facilitates permanent and temporary trade in water entitlements, annual allocations and an improved delivery capacity represents great opportunities for irrigators to diversify, streamline and strengthen their businesses in the future. Water markets based on voluntary exchange have allowed buyers to reduce the impact of drought on farms either by selling their water to earn income during times of low allocations or to increase the water they can use for irrigation. Changes to water balances over time will result from changes in land use, climate, demography, and industry and water policies.



Water trading ... is creating open and competitive markets where water use is managed rather than administrated by governments.





From left: Otto Szolosi, John Owens, Dan Tarlock, Sandra Zellmer, Sandra Postel, Marc Andreini

Governments have a responsibility to ensure that water is allocated to achieve socially and economically beneficial outcomes in an environmentally sustainable manner. Policy alone will not resolve Australia's water problems. Major spending is required to expand the infrastructure to improve water management.

The water shortage has caused even Australia's farmers to find new solutions and adapt. Their key management strategies include reducing the total area irrigated, reducing water application rates, implementing irrigation scheduling, substituting crops that use less water and planting cover crops. Water trading, increased groundwater pumping and water recycling also are effective tools.

"Past experience and ongoing projects prove that, yes, we can and we must make better use of our water resources," Szolosi said. "We just have to open up, put our heads together, and make sure that all the information across the countries will get into one basket like this Global Water for Food Institute and use this resource in the right way."

Questions and Answers

Vicky Weisz, Research Professor, UNL Center for Children, Families and the Law:

What are some strategies to speed up getting the appropriate institutions in place to address the problems described, and how might the prospective institute provide an understanding of how we can reduce the lag time between seeing a problem and getting the necessary institutions in place to address it?

Sandra Postel answered that change comes from evolution in leadership and from grassroots pressure. How this happens depends on the local culture, geographic location and government system. She described how South Africa's change in the political regime, including naming a human rights lawyer as the head of the cabinet that governed water and forestry, brought a sense of ethics and human rights into water law that otherwise might not have happened. There are many examples of citizens mobilizing for change, she said, describing a case in Massachusetts where there was renewed interest in building a diversion dam to supply water to Boston. A mobilized group of residents forced people

to think about conservation as a serious alternative. As a result, the state implemented incentives for a conservation strategy and did not build a dam.

Dan Tarlock had a shorter answer: Development takes money. Money is needed to fund the institutions, especially in the developing world. Tarlock also stated that an organization like the Global Water for Food Institute could provide cross-training to help water professionals established in one discipline become more fluent in other areas.

Mohamed Bazza, senior water resources officer for the Food and Agricultural Organization of the United Nations, said experience has taught him that the dimensions of policies, institutions and legal issues are more important than the scientific and technical aspects in addressing the world's food and water issues. The institute's approach to changing the culture on water and promoting the right policies and governance is crucial to addressing the issues that are being discussed. The recently released Third World Water Development report confirmed its previous conclusion and the conclusion of other reports, including the International Water Management Institute's, that people should not be alarmed that the world will not have enough water for food production in 2050. The crucial problem is how to use the water, which is what the new institute should concentrate on, Bazza said.

Sandra Zellmer pointed out that discussion is needed about education and how to prepare students to develop water management solutions to sustain and better use the water supply. She described the University of Nebraska's new Integrated Graduate Education and Research Training (IGERT) program funded by the National Science Foundation, which focuses on issues related to resiliency and sustainability in watershed management. The program brings students together in interdisciplinary teams to break down disciplinary divides.

Postel said there are examples of effective policies that can achieve the level of food productivity needed in the future. In her opinion, the solution involves a combination of subsidies dealing with pricing and rate structures and preservation of ecosystems, which effectively boosts water productivity. These things work in tandem and as individual efforts but haven't been mobilized on a large scale. It is clear that water policies need a complete reform, Postel said.



Change comes from evolution in leadership and from grassroots pressure.