

Water Agenda

Water is essential for life. Everything that lives needs water, and in many instances lots of water. In spite of this obvious fact, water is often not valued properly and consequently overused. While there is more than enough water on earth, there tends to be a mismatch between where freshwater is available and where it is most needed. More than half of the world's larger cities, for example, lie in water-stressed river basins with aquifer depletion, water pollution, or insufficient water for the environment. Water stress affects us all and leaves, in particular, two of the heaviest water users, agriculture (food security) and energy generation, vulnerable. Corporations increasingly see potential disruptions in their water supply as a risk to be reckoned with. And yes, poor water quality gives way to water-borne diseases with significant human and economic costs. While the world gradually awakens to those challenges, what is needed is a better understanding of the multiple ways in which water interacts with its social and economic environment. It is in particular at this intersection that I define my research, teaching and other water-related activities.

Water Research

One line of my water research is directly informed by my work as an international economist, and investigates water scarcity in a global context. A second line is more micro-oriented and focuses on water markets, and their impact.

In *The Global Economics of Water, Is Water a Source of Comparative Advantage?* I investigate how the availability of freshwater determines what countries produce and trade. I show how a country's relative water abundance drives its exports, and how international trade allows relatively water-scarce countries to reduce water stress by importing more water-intensive goods from more water abundant areas. My estimates indicate, however, that a country's available capital, land and human capital plays a far more important role for trade and production patterns than its water. This should not be a surprise since very water-intensive agriculture constitutes but a small fraction of the world's GDP. An immediate implication is that poor countries that rely more heavily on very water-intensive agricultural production are exposed to changing precipitation patterns and droughts.

In *Decomposing U.S. Water Use since 1950. Is the U.S. Experience Replicable?* (with Amanda Kurzendoefer) we explain the remarkable pattern of U.S. water use. U.S. water use increased until 1980. Since then, it has remained stable and even decreased some in spite of continued GDP and population growth. We show that the ever-increasing water productivity in the United State has been driven by the changing structure of the U.S. economy (growing importance of services)

together with technological improvements that can be linked to the Clean Water Act and efficiency gains in the electricity generating sector.

In a recent report for the Nature Conservancy, [Water Stewardship for Sustainable Prosperity](#) (with Nathan Karres and Kari Vigerstol), we situate my and related research in the broader context of sustainable development. In particular, we discuss what it would take to de-couple economic growth from water use, which we place at the heart of a holistic approach to water stewardship.

Current projects in this same vein investigate the interaction between population growth and water availability in a global economy (with Megan Konar and Paolo D'Odorico) as well as the relationship between water availability and protectionism. I am working on the Global Economics of Water. Two CEPR Vox articles summarize my research in non-technical language: [Using Water Resources Efficiently on a Global Scale](#) and [The Remarkable Pattern of U.S. water use](#).

In recent years, I have been researching water markets in the United States and abroad. This work has more of a micro bent. Water markets are like carbon markets, in essence, cap and trade systems in which the right to use water is bought, sold or leased (independent of the land title). Water markets have potential as a tool to fight water scarcity since they help redistribute water and, at least in theory, can channel it to its most efficient use.

In [Water Markets as a Response to Scarcity](#) (with Brian Richter and team of UVa grad students), we document and describe a few key water markets in the U.S. and abroad. Even though water markets are increasingly popular in developed and developing countries, one of the key challenges is to understand exactly how they function. Apart from market simulations exercises, to date there have been no before-and-after studies of actual water markets and how they affect production patterns.

In [The Effects of Water Markets: Evidence from the Rio Grande](#) (with Tiansu Li), we fill a gap in the literature and trace out how a prominent U.S. and relatively old water market (Rio Grande in Texas) has altered land and crop use. We show how there is a shift in the composition of water markets towards more high-value crops in counties that install a water market compared to others that do not have a water market since the establishment of the market. We also find that there is a tendency for droughts to amplify this compositional change. This research is tightly linked to ongoing field work.

With a team of researchers from the Nature Conservancy and a \$400,000 Rockefeller grant, we have been studying water markets and how they might be used to safeguard water for the environment. In our report to the Rockefeller foundation, [Community Water Trusts; A Global Initiative to Address Water Scarcity](#), we conclude that, except for when water markets are thick, well developed and covering both ground and surface water, conservation strategies that involve water markets may well have to be complemented by land acquisition to secure enough water for the environment.

Cases and Teaching Global Economics of Water

At the Darden Business School, I designed and teach a unique class for 2nd-year MBAs on the *Global Economics of Water*. Since businesses typically think very little about water use and how they are linked through global supply chains to water-scarce areas, the course is eye-opening for many. The course falls into three parts. We first place water use in the global economy, taking our queues especially from Singapore, which in many respects is an example as to how to handle water availability challenges. We then look into key policy challenges that relate to water: the tragedy of the commons, water pricing and water markets. In the last part of the course we specifically study how companies and NGOs engage water issues, with particular attention for impact investing in water and corporate social responsibility. External visitors to the class vary from year to year, but we have had Paolo D'Odorico, Brian Richter (TNC), Dick Brownlee, Koch (Coke), and (WWF). In the recent past, together with Brian Richter and Paolo D'Odorico we have held a Diplomacy Lab on Water Security with the State Department, taught a joint class on Sustainability and Water for students from Engineering, Environmental Science, Public Policy and Business, and held a water seminar for graduate students about water markets.

Here is a list of water-related cases and technical notes that I have written (They are all available through the *Darden Business Publishing (DBP)* or through Harvard Business Publishing website)

Rio Tinto: Making Hay from Water shows how corporate social responsibility pushes mining companies towards more sustainable water use. Whether that is far enough, is an open question.

Saudi Arabia: Oil for Water places Saudi Arabia's water and economic policies (including its most recent "land grabbing") in the socio-economic context of this very arid country.

The Nature Conservancy: Advocating for and Investing in Sustainable Water Management (with Brian Richter) takes The Nature Conservancy's activities in Australia's Murray Darling Basin as starting point to investigate ways in which NGOs can finance water conservation through impact investing.

NaanDanJain: Every Drop of Water Counts. Drip Irrigation and the Fight against Water Scarcity (with Allison Elias) follows the success as well as the challenges of the Multinational Jain and its Israeli affiliate NaanDanJain. At the same time, we compare the very different Israeli water policy context with that of India and how this impacts innovation and drip irrigation adoption.

Water for Grain. The Great Plains in a Time of Globalization contextualizes the tragedy of the commons in the U.S.' breadbasket that during the depression was also the site of the American Dust Bowl.

Securing a City's Future Water Supply. Building a Water Reservoir in Charlottesville (with Brian Richter) illustrates how providing for a community's water is a public good that invites a

multitude of stakeholders. The case explicitly introduces “water for the environment,” a component often forgotten in water discussions.

The Big Dry and Water Markets in Australia, shows how Australia’s drought put it at the very frontier of using water markets in its fight against water scarcity.

Private Provision of Public Goods is a technical note that highlights the economic challenges for NGOs providing public goods.

Public Provision of Water links public water supply to the problem of the natural monopoly.

Withdrawing Water from an Aquifer: The Economics draws on the literature in natural resource economics on how to optimally extract water from a finite resource.

The Water Cycle, Climate Change and (some) of their Interactions (with Paolo D’Odorico) points out how central the water cycle is to climate change, and what changes in the water cycle are to expected.

Water Markets from an Economic Point of View lays out the main mechanisms of water markets.

A Framework to think about pollution: Externalities, Pollution Taxes and Cap and Trade brings in externalities, how they disrupt the proper functioning of markets and how externalities can be internalized.

Other water activities

For the last few years, around the UN’s world water day (March 22nd), I co-chaired with Brian Richter the **World Water Events**, which is a series of water-related talks and activities across the University of Virginia. (see: <http://uvaworldwater.org/>) This has been a cooperation between Environmental Science and Environmental Engineering, the Darden Business School and its Institute for Business in Society, the Center for Global Inquiry and Innovation, the Global Institute for Institute for Global Health, The Nature Conservancy, The Rivanna Conservation Alliance and the Vice President’s Office for Research.

Between February and March 2016 we had a whole series of events. Peter Brabeck (Chairman of the Board an former CEO of Nestle) gave a keynote speech about the water challenges we face and what can be done about it. There was a research talk in Environmental Science, a practitioner talk on water and cities (Nature Conservancy) as well as a panel on storm water at the Law School

In March – April 2015, Sandra Postel (National Geographic) gave a keynote address about the future of water use. There was also a research lecture by Prof. Hornberger scheduled in Environmental Science Department, as well as one by Dr. Galloway in Environmental Engineering.

At the Darden Business School we held a panel discussion on water scarcity in California and how it poses challenges as well as opportunities for business innovation (with Norley (entrepreneur), Szeptycki (Stanford), Radtke (Coke North America)). With students and faculty we participated in a clean-up effort of the local Rivanna River in cooperation with the Rivanna Conservation Society.

Media: NBC29, Daily Progress, Green Podcasts with Postel, Septycki, Norely, Radtke

In March of 2014, a one-day symposium took place at the University of Virginia with a keynote by Jamie Pittock (WWF) on water stress and the need for a flexible policy response. There also was a panel on the challenges and opportunities of water markets plus and a panel discussion on the need for more access to safe drinking water and the health implications (with focus on South Africa). The symposium was preceded in January by a talk by Brian Richter (Nature Conservancy) on water scarcity.

Media: NBC29, UVaToday, Newsplex.com, Darden Business Cast (March 21, 2014), NPR (91.1 FM WTJU), Green Podcast with Jamie Pittock and Brian Richter (May 2, 2014).