Hydrologic Sciences Early Career Award:

Megan Konar, University of Illinois at Urbana-Champaign

I am deeply honored to receive the Early Career Award in Hydrologic Sciences. This award is particularly meaningful to me because my research is interdisciplinary, yet I have always felt welcomed and encouraged by the AGU hydrology community. Thank you to my mentors and colleagues who nominated me for this award. I am especially indebted to my amazing students and collaborators, with whom I share this award. I am also grateful to my many amazing colleagues in the hydrology community who make it such a great community.

The goal of my research is to better understand how to achieve water resources sustainability while simultaneously enabling supply chains to promote food security. In my research, I seek to understand the implications of water resources for supply chains, as well as how supply chains, in turn, impact water resources. I conceive of water hazards and unsustainable water use as a risk facing supply chains. In the process of working to understand the impact of supply chains on water resources I have come to realize that social sciences has much to offer on how to think about coupled human and natural systems, including how to determine the impact of social drivers on resource use. I think the hydrologic sciences community (particularly those of us working on water use, or other topics with explicit human interactions) could take cues from social scientists, who have been thinking rigorously about how to handle observational data related to humans for many decades.

I have come to realize that determining the impact of supply chains (or trade) on water resources is a question of causality. This is why I have started to incorporate modern econometric techniques to better understand the causal impact of trade on water resources in recent work. Going forward, I intend to continue to focus on using causal inference methods to understand the drivers in complex human-water systems. Empirical research at the interface of societal water use could benefit from modern econometric methods. I would like to use this article as an opportunity to explain what these methods are and how research on water and society can benefit from the use of these tools.

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What is econometrics? When we deal with human-water systems, we have to be particularly wary of "selection bias". Selection bias occurs when people have the ability to opt-in to a "treatment" of interest (e.g. policy, management decision, etc). The main example I like to give is for determining the impact of hospital (a treatment) on health. If we were to look at health outcome for people who went to hospitals compared with those who do not, we would see that health outcomes are worse for the group that goes to hospital. However, the people that go to hospital are different to those that don't go (i.e. they are sicker to begin with), so the difference in means between these groups would not reveal the causal impact of hospitalization due to this selection bias.

In the water resources context, we may be interested in the impact of crop insurance (a treatment) on water use. In this case, we would have to recognize that the farmers who choose to receive crop insurance are inherently different to farmers who do not purchase crop insurance. This inherent difference between these groups of farmers is selection bias. These differences may drive their water usage rather than the crop insurance. For this reason, looking at the relationship between crop insurance and water use in the data would not indicate the causal impact of crop insurance. The same is true of trade (also a treatment), because nations decide how much they are going to trade, which means they select into levels of the treatment.

What can we do? Ideally, in order to determine the impact of any treatment, including crop insurance and trade, we would randomly assign the treatment to the study groups. In other words, we want to pretend that we are a pharmaceutical drug company running a drug trial. To determine the efficacy of the drug, the pharmaceutical

company needs to randomly give pills with the medication and placebo pills to patients. The random assignment of the medication enables the pharmaceutical efficacy to be determined. The same is true of any other social intervention – such as a policy, infrastructural improvement, etc. Ideally, we would like to randomly distribute the treatment in order to properly assess its impact on an outcome that we care about. Here, the experimental ideal would be random assignment of crop insurance to farmers or random assignment of trade to world nations.

It is often impossible, infeasible, or unethical to randomly assign treatment. We will never be able to witness a counterfactual world in which we randomly assign countries to trade or not to trade with one another. For this reason, econometricians have developed a wide array of methods to use naturally occurring (i.e. non-experimental) data in clever ways to tease out causal relationships. The main obstacle that these methods seek to overcome is selection bias. Econometric methods are very careful to form the appropriate control group for comparison in order to assess the impact of the treatment of interest. They do this through several core approaches, including instrumental variables and differences-in-differences. Although econometrics often relies on standard statistical techniques (including regression analysis) the main technical contribution is in the interpretation of the coefficient of interest: the goal is to move beyond correlational understanding between two variables and pin down the causal relationship.

Going forward, I think there are many exciting opportunities to apply the tools of modern econometrics to water resources research. Identifying causality in complex human and water systems is of core interest to both science and policy. The field of economics has spent several decades developing the theory and empirical tools of identification of causality of a treatment in human systems. We can now benefit from the fruits of their labor and glean new insights into human-water systems.

Hydrologic Sciences Early Career Award:

Kaveh Madani, Yale University

I am delighted and thankful for being selected as one of the recipients of the Hydrologic Sciences Early Career Award in 2019. I owe this incredible recognition to my inspiring mentors, collaborators and students. I sincerely thank my supportive colleagues for kindly nominating me for this award.

Choosing water as my field of expertise was not unexpected. My parents both worked in the water sector. I was their only child and spent a lot of my childhood with them when visiting water infrastructure around my home country, Iran. Discussions on water management were common at our home and developing passion for water was natural for me. My parents were both on the planning side of water management, but I decided to become a civil engineer during Iran's dam construction boom.

During undergraduate studies, I served as the head of the civil engineering students club at the University of Tabriz and an executive member of the national civil engineering students club. This was my first exposure to operations in real world where I learned that financial restrictions, legal barriers, conflicts of self-interests, and power competitions can kill good intentions and block positive movements.

I moved to Sweden at the age of 22 to get my master's in water resources at Lund University. After taking a system dynamics course, I ended up developing my first model of coupled water-human system in my M.Sc. research. My modeling results were interesting, counter-intuitive, and controversial. I had found that water transfer to meet the increasing water demand in central Iran could exacerbate water shortage. The main reason for this finding was coupling my traditional hydrologic sub-system with a social sub-system that helped me internalize some variables that are normally treated as exogenous variables (e.g. water demand and population growth) in water resources modeling.

My numerical water-human system dynamics model was highly speculative but got me interested in exploring unintended consequences and unexpected behaviors in managing water later in my career. The encouraging feedback I received from Pete Loucks, Rolf Larsson, Jonathan Bulkley, and the late Miguel Mariño motivated me to continue this line of research later in career.