

July 1, 2024

Re: Response to Request for Public Input on America's Groundwater Challenges

Dear PCAST Groundwater Working Group Members,

I appreciate the opportunity to provide input on the six questions included in this [post](#), which was recently brought to my attention. My comments are informed by my work on groundwater, which ranges from local to international and includes involvement in the federally authorized U.S.-Mexico Transboundary Aquifer Assessment Program since its inception. My perspectives draw upon my extensive groundwater policy and management experience, which includes on-the-ground involvement, along with academically oriented analyses of groundwater governance, managed aquifer recharge, and more. Additional information about my body of work can be found [here](#).

Question 1: How can we enhance the timely collection of data on groundwater inventory, use, recharge, and flow across the United States to gain a whole-of-country picture of the nation's groundwater resources?

Enhancement of timely collection will be incentivized by establishing data collection practices, a community of data providers and users, and adequate funding over time. Because groundwater is local, much information is locally generated. While satellite imagery is helping with groundwater quantity information, it alone is not sufficient. With advances in cloud storage of and access to data, a key challenge is in the collection of data on both quantity and quality. Groundwater is more of a stock than a flow resource. A complete picture is needed spatially, and data must be collected over time. A single snapshot will not be sufficient to advance sound management of groundwater resources. Should USGS' National Water-Quality Assessment Project (NAWQA), which I understand has been canceled, be reinstated? If a goal of the working group on America's groundwater is to advance timely, whole-of-country collection of data on groundwater, which is a very big task, I suggest that a broad working group representing states and Native Nations, along with other water experts be formed (if you have not already done so).

Question 2: How can we effectively model and predict changes in the inventory, recharge, and flow of groundwater in the context of the overall water cycle and provide that information to stakeholders and decision-makers?

Groundwater is a local resource, and it is not visible. Questions about the details of effective modeling can best be answered by modelers. A key question relates to the metrics that useful for stakeholders and decision-makers. As a member of the (Arizona) Governor's Water Policy Council, I was the recipient of information of groundwater declines based on data gathered from index wells. However, in some groundwater basins, very few index wells exist. Can just a few wells be relied upon to provide information about a basin? Wells are most often under private ownership, meaning sharing data from these wells is up to the owners. I provide this as just one example. There is need is for reliable data that feed into the modeling.

Question 3: How can we efficiently scale groundwater recharge while mitigating risks?

A theme of these responses is that groundwater is local. Aquifer conditions are aquifer specific. Recharge infiltration rates associated with basin recharge projects, such as those deployed in Arizona, can vary from basin to basin for an individual project. So, modeling of recharge conditions and recharge

performance will be specific to the location of the basins. Injection recharge will have different/additional considerations. In May 2022, the Boards of Earth Sciences and Resources and the Water Science and Technology Board, National Academies of Science, Engineering, and Medicine, convened a workshop on the future of Managed Aquifer Recharge in the United States. There was some mention of a panel being formed to do a NAS-style report. I do not know if such a panel was formed. UNESCO's [volume](#) on successful MAR includes five cases from the United States. I have been involved in other collections of MAR experiences. A global expert in recharge told me that there are few researchers focused on the water quality implications of groundwater recharge. The International Association of Hydrogeologists (IAH) has a group specifically focused on Managed Aquifer Recharge. There is a ready cadre of MAR experts (both here in the U.S. and internationally) who would be excited to participate in answering this question in some detail.

Question 4: How can we ensure clean and safe groundwater, especially for the communities that are affected most by groundwater contamination and depletion?

Ensuring clean and safe groundwater is so important yet can be elusive. Sufficient monitoring is needed. Note that water quality testing is expensive and difficult to accomplish not only for communities but also for the many individuals who own their own wells. I have received many inquiries over the years from individuals who are looking for assistance in assessing the water quality of their wells. Unfortunately, they are usually on their own. Water management regulations can affect groundwater availability for municipal use, whether at the community or individual level. This is another big issue and one that must be addressed at the state and/or local level. Groundwater quantity is not managed federally, but minimum water quality standards for drinking water and water discharges are federally established. The connection between surface water and groundwater is highly relevant, whereas many states do not regulate/manage the two water sources conjunctively. Federal-state-local partnerships and cooperation will be required. Sharing the assessment experience of the Transboundary Aquifer Assessment Program along the U.S.-Mexico border, where there is a federal role, could also be relevant.

Question 5: How can we engage with communities to successfully ensure a sustainable supply of groundwater, including for agriculture, industry, energy, human consumption, and healthy ecosystems and biodiversity?

The quest for groundwater sustainability is noble. Understanding the role of groundwater in all these arenas is critically important. As a participant in global discussions of groundwater, where the end-goal is all that is mentioned in this question, I can attest to the difficulty of even getting on the same page as to the role of groundwater. Some see it mainly as a buffer in times of surface water shortage. They see groundwater use as an adaptation to climate change. In some water dialogues, groundwater is barely mentioned. For example, groundwater is hardly mentioned at annual meetings of the Colorado River Water Users Association. Yet, for some communities it is and has been “the” or a major source of water. Understanding of groundwater and aquifer conditions is necessary. Common understanding of the implications of the various uses of water, both groundwater and surface water is a prerequisite to moving toward sustainability. But sustainable use of groundwater may be difficult in many settings because groundwater is finite. Even in California, where the goal is sustainable groundwater use, meeting the goal is expected to take many years. Some have focused on the concept of “managed depletion”. However, a difficult question to answer relates to establishing an acceptable rate of managed depletion. What is acceptable? The answer will likely vary depending upon whom you ask, and the answer may change over time as the implications of pumping rates are realized. Ensuring all of what is in this question is our big water challenge, regardless of the water source. I prefer to stay away from using the word “ensure” because I do not think it’s possible for anyone to ensure all of this. Regarding engagement, which is central to all that I do, I would offer that engagement must be an ongoing effort and meaningful. It cannot be just a one-stop “helicopter in” type exercise. Engagement is two-way. I like to distinguish between expert engagement and more general engagement, which is how I read the words “community engagement”. They need to believe devoting time on water matters is worth taking time from their jobs

and/or personal lives. Sometimes engagement is more forthcoming due to crisis or urgent conditions. Relationships and networks must be built. Resources must be provided to those coordinating and carrying out engagement activities.

Question 6: What strategies and incentives can help limit groundwater over-use?

Again, you ask a fundamental question, one that many have grappled with for some time. I include groundwater over-use as an example of a wicked water problem. Wicked problems do not have single, easily implementable solutions. Work on identifying and implementing solutions pathways takes broad, interdisciplinary involvement. Monitoring groundwater use and quality is needed but difficult to accomplish broadly due to the underlying regulatory framework(s), costs, and possibly other considerations. Then the strategies to limit groundwater use have to be developed. Once approved, then implementation and reporting/monitoring for compliance must occur. It could be useful to look at Arizona's recent experience at developing a rural groundwater management framework. Here, after many months, efforts to identify a bipartisan approach to establishing a locally tailored framework continue. The experience shows some of the difficulties of getting on the same page in terms of characterizing and addressing the issue(s) of groundwater over-use. Raising public awareness can be very helpful. It is important that people know where their water comes from, the answer not being "from the tap", recognizing that, even in the U.S., not all have ready access to tap water to meet household needs. Regarding public awareness, I will note that the Football (Soccer) for Peace effort has identified groundwater as a focal area for its international efforts. I can make an introduction if you would like to learn more. Football for Peace hosted an event on the Capitol Mall on World Water Day (March 22, 2024). School programs, such as those of Project WET (Water Education for Teachers) can be effective at changing behavior of students and their families. Incentives often are financial, which requires funding, but can also be in the form of highly visible competitions and award programs. It may sound trite, but we do need all hands on deck.

Thank you for the opportunity to provide input. Please let me know if you have any questions or would like further information.

Sincerely,



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