Rohini Nilekani | Making invisible water visible

The capricious nature of groundwater has resulted in so much exploitation and overuse that we now have a consistent crisis. Presenting a roadmap for groundwater governance and information transparency using technology

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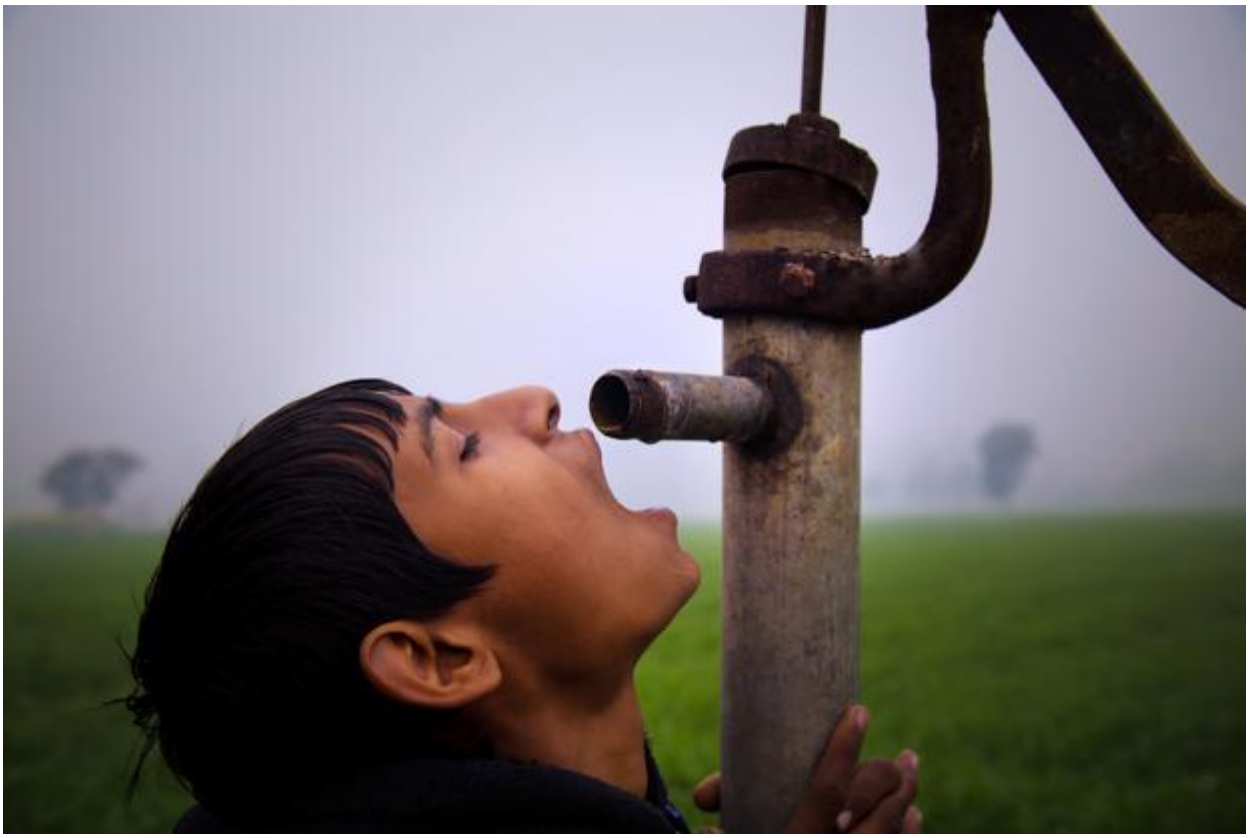
Rohini Nilekani says open data platforms should be created to make invisible water visible. Photo: Abhishek B.A./Mint

India is a groundwater civilization. Almost all Indians use groundwater, directly or indirectly, each day. This tradition goes back more than 2,000 years. India is criss-crossed with the most elegant wells that tap into the shallow aquifer. The oldest wells yet discovered, in Sarnath and Lothal, date back to the Harappan age. Hill dwellers across the Himalayas and the Western and Eastern Ghats have used springs, nature's way of bringing groundwater to the surface, since time immemorial.

Being near a water source can determine lives, livelihoods and prosperity. While all water is eventually connected, groundwater, unlike surface water, is nearly ubiquitous. It is replenishable, it is almost free and it can be pulled out as needed, without spending on overground storage systems. This makes it a perfect resource for lifeline use, for farming, and for any other demand.



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Yet groundwater is also invisible and capricious. It can fool you into believing there is an infinite Patalganga flowing beneath your feet. Depending on which of the many hydrogeological zones of India you tap into, the water can either be easy to reach or incredibly difficult to suck out.

If you live above the hard rock aquifers of the basalt and granite geological zones of peninsular India, you might find the water beneath you to be an escape artist, unless you learn to harness it. If you inhabit the Indo-Gangetic floodplains of northern India, you will find the water easier to access but also easier for anyone to contaminate.

In most cases, if you are in a discharge zone, your well might be the first beneficiary of a good monsoon. If you are in a recharge zone, you might be an unwitting philanthropist for a neighbour's well.

This invisible and capricious nature of groundwater has resulted in so much exploitation and overuse that we now have a very visible and consistent crisis.

Surveys by the Central Groundwater Board (CGWB) and other agencies, including the Indian and US space agencies Isro and Nasa, paint a frightening picture. At the very least, a third of groundwater blocks are described as semi-critical, critical or overexploited. Since 85% of India's drinking water needs and 65% of the country's irrigated agriculture depends on groundwater, this means we are heading for some serious social and economic consequences.

Many of those consequences are already obvious. Even in agriculturally rich zones, farmers incur increasing debt to dig deeper and more borewells. Hundreds of millions of people face serious health risks from the fluoride, arsenic, iron, nitrates or harmful bacteria in their daily water. In rural and peri-urban areas, heightened competition for the same, finite groundwater is leading to open conflict with industry and urban settlements. In urban India, inadequate, inefficient and inequitable municipal supply has resulted in a race to the bottom to draw groundwater of any quality from any locality at any price.

Governments at all three levels—Union, state, and local—have grappled with this problem for more than a decade. The Union government has recently updated a model groundwater Bill, and some states have formalized new groundwater policies. All recent water-related policy documents have created better frameworks for integrating groundwater into overall water management. Diverse participatory groundwater management experiments have spread across the country, the best known being the Andhra Pradesh Farmer Managed Groundwater Systems (APFMAGS). The Union government, together with the World Bank, will soon deploy a $1 billion (around ₹ 6,600 crore) programme called the Atal Bhujal Yojana in seven states, designed to incentivise the reversal of groundwater decline in thousands of habitations.

Yet, the problem continues to worsen, and no complete solution is in sight. Several structural issues remain unresolved.

For one, land and water rights are entwined in India through common law, and also because some colonial era laws remain unchallenged. There are other laws that constrain this right, so it is not an insurmountable obstacle. Yet the question, "Does everyone have the right to extract the water under his or her property?", has not been fully answered yet.

If the answer is yes, then it becomes a free for all.

If the answer is no, then technically, no one can draw water from nearby springs or wells without permission or licence of some sort.

Indeed, whether water should be treated as a public good held in trust by the state or whether it is to be recognized as a common pool resource managed by communities through social protocols is at the very heart of the debate on groundwater futures.

While this uncertainty remains, the very nature of groundwater makes it possible to access it anywhere, anytime, provided people have the capital. And so this common pool resource becomes a de facto private good, or an open access resource. Private over-extraction and unrecognized, unregulated groundwater markets are already creating havoc in the countryside. Currently, no proper regime exists to control this trend.

This situation was exacerbated in the 1970s and 1980s, when powerful new rigs and diesel pumps made it easy to pull out the then abundant groundwater from the deeper aquifers. It allowed farmers to bypass the surface irrigation networks with all their inadequacies and created individual control over a key resource. This was further incentivised with the political blessing of subsidized or free power.

There are estimated to be more than 33 million borewells and open wells in India, though no one has an exact number. Most of these are privately owned, largely by farmers. There is no published data on how many of these wells have failed permanently, or on how many new wells are being dug or drilled every year.

Everyone agrees that this is unsustainable and must not continue; yet there is neither the state capacity nor the political will to regulate private extraction in the near term. Imagine, as a politician, telling one owner of a private well in your constituency that the state, which you ostensibly represent, plans to take over his well. Now multiply that by 33 million. Even if that were possible, there is no regulatory infrastructure to manage groundwater in a just, equitable and sustainable manner.

But perhaps the most vexing structural issue is the invisibility of the aquifer. Water from rivers, streams, or even from dug wells, gives continuous visible clues about availability. But with deep aquifers, it is difficult to assess boundaries, storability and yield.

What cannot be seen is even harder to manage. So everyone dips into the same finite pool without even knowing it.

There is increased, intense competition, which then explodes into conflict at various levels. Knowledge and power asymmetries become sharper. Those with more money, power, knowledge and access can use or abuse the resource with more impunity; at least until the wells all go dry.

Thankfully, we need not dwell for long on such doomsday scenarios.

Today's technologies can make invisible water more visible than ever before. Some are top-down; some are bottom-up. Together it is a potentially powerful combination.

Satellite imagery, combined with algorithm-based software, can help map aquifers and detect water abstraction just from the alteration of gravitational pull. Sophisticated yet widely available rainfall pattern modelling creates more predictability about the resource. Locally, sensors and meters placed at borewells can yield information on the depth at which water is available, its quality parameters, and more. Simple rainfall gauges can corroborate the models based on satellite and software.

All this mapping data can now be visualized and put into simple graphs and images to help people "see" their aquifers. Apps can be designed to allow individuals, communities and local governments to continually monitor water use and decipher trends.

Right now, this technology revolution is well under way. Satellites ringing the globe are yielding astonishingly granular details of water resources, extraction and flows.

Unfortunately, much of it is either in private hands behind pay walls or in state hands behind secrecy walls erected for various reasons.

We have limited information on how the state and the markets are currently using this data.

But what if all this rich information were available in the public domain? What if millions of wells became data points to create rich, detailed maps of aquifers, their yield, quality and usage? What if all this data were creatively visualized and put into mobile-friendly apps? What if an open, interoperable, transparent, public platform were designed to allow people to enter data on groundwater in a verifiable manner to make it shareable and discoverable? What if a data analytics capability overlaid that simplified decision making? What would it all unleash?

Yes, it might first deepen knowledge and power asymmetries that already exist in such cruel forms. But done properly, it could increase the ability of groups of users to

rationalize and optimize their water use. It could jump-start innovation and creative collaboration as yet unimagined. Communities—urban and rural—could use such a platform to understand trade-offs, change behaviours, and self-regulate excess.

In places where participatory groundwater management has already been in practice, communities have been trained to use science and data to map aquifers to the extent possible. They have developed social protocols such as borewell pooling or crop optimization to prevent over- extraction. They have prioritized drinking and lifeline water for all residents. They have understood recharge capacities and built physical structures to retain water. Over time, these practices, when sustained, allow people to deeply internalize that when it comes to groundwater, the individual good might lie in the common good, or at least cannot be divorced from it.

Creating open data platforms to make invisible water visible is the first and probably most doable part of the road map towards better groundwater management.

However, the most critical aspect of unleashing the potential of new technologies is the simultaneous and deliberate work of activating people's own capacity to understand aquifers and develop sustainable behaviours to manage local water. This aspect cannot be overemphasized.

Hopefully, over time, these two phases will lead to a desirable end state, where water is neither a free for all nor taken over fully by the state. Rather, all water would be managed through nested institutions at appropriate levels, built on the principles of subsidiarity. The market or bazaar would play its role too, but governed and regulated by the state or sarkar. Ideally, both would operate under the watchful eye of the institutions of society or samaj to ensure that the power vested in the state delivers safe, sustainable water for all.

Rohini Nilekani is the founder-chairperson of Arghyam, a foundation that works towards providing safe, sustainable water for all. She has also co-founded and funded Pratham Books and Ek Step.