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Can We Have Our Water and Drink It, Too? Exploring the Water Quality-Quantity Nexus

BY DANIEL STELLAR|OCTOBER 28, 2010

Comments

I recently returned from World Water Week, in Stockholm, Sweden, where I spoke on the relationship between water quality and quantity, as part of a workshop on shortcutting historical pollution trends. Water quantity and quality have generally been considered as separate problems and have usually been treated as such in policy-making and environmental restoration efforts. Increasingly, however, research and experience is beginning to show a strong link between water quantity and quality. In fact, at the Columbia Water Center, we have long considered water scarcity to be the root cause of many other water challenges, such as water pollution and access to safe drinking water. Some of our project work, in fact, explicitly demonstrates how improvements in quantity can also drive improvements in quality.

The island of Cyprus faces increasingly frequent periods of severe drought and heat, which exacerbate pressure on the island's already overdrawn freshwater aquifers. As stress on coastal aquifers increases, so too does their susceptibility to saltwater intrusion. If current groundwater

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Name

consumption rates continue, the aquifers may become unfit for human consumption. (Source: Wikimedia)

To date, traditional means of providing safe, high-quality water include biochemical treatment, pollution and consumption regulation, and infrastructure development. These avenues, however, are often blocked by monetary, energy, and/or regulatory limitations and thus, have proved insufficient to adequately ameliorate water issues in many areas where large-scale improvements are urgently needed. At World Water Week, I posited that in some cases, using conservation-based methods to increase water quantity could also remedy problems of water quality and access. This is based largely on the fact that water quality degradation is not always solely a product of external pollutants but is sometimes caused by quantity depletion.

The link between quality and quantity can take different forms in the cases of ground- and surface water. Where subterranean aquifers are concerned, there is an explicit connection between over-use and quality degradation. Excessive pumping of groundwater over time can diminish water quality in two ways. First, the concentration of naturally occurring compounds can become dangerously high as the amount of water dwindles. An example of this is observed in India, where the increase in groundwater fluoride concentration over 8x the natural amount is causing increasing incidents of Fluorosis, a disease that weakens teeth and bones.

In other cases, such as on the island nation of Cyprus and in the contested Gaza strip, water users face increasing salinity levels as a result of saltwater intrusion into their coastal aquifers. This occurs when over-pumping lowers the water table below sea level, allowing saltwater to seep into the aquifer; over time, saltwater intrusion can render groundwater unfit for either human consumption or agricultural applications such as irrigation.

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Name

The Rio Grande, which runs through The Southwestern US and Mexico, is a river that has been subject to industrial and agricultural pollution. However, contamination levels in the river are exponentially higher in summer months when overuse of surfacewater result in diminished flows and, consequently, higher concentrations of harmful contaminants. (Source: Wikimedia)

When the source being used is surface water (such as freshwater rivers and lakes), over-use leading to decreased water levels increases the concentration of harmful substances already present in the water due to pollution or mineral leaching. A marked example of this is seen in the case of the Rio Grande River, where decreased flows in summer months coincide with large declines in water quality. During the dry season, pathogen concentrations increase by almost 100 times.

Despite the multiplicity of sources, locations, causes, and effects of the water issues mentioned above, one solution may serve them all. Conservation-based schemes focused on increasing the quantity of water available could provide a more effective and cost-effective solution than traditional approaches aimed at improving the quality of continually diminishing water supplies. In Gujarat, for example, the Columbia Water Center is engaging in work designed to help farmers conserve water. While this work involves working with the state government, it is important to note that our proposed solutions are entirely revenue neutral to the state. Through our work, we aim to stabilize, and hopefully increased groundwater levels over time. In addition to the myriad benefits provided by this increase in quantity, there is also potential for dramatic increases in quality. Ideally, our work will prevent the catastrophic saltwater intrusion that will otherwise likely be caused by the ongoing depletion of groundwater under the business as usual scenario. In addition, higher levels of groundwater will lead to a decrease in the fluorides and salt currently present in water used for individual consumption.

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Name

In Gujarat, India, the Columbia Water Center is working with local government and farmers to reduce profligate water use, which is resulting in diminished groundwater quality. Here, team members work with local farmers to instal a tensiometer in an irrigated field; the device allows farmers to reduce and maximize the efficiency of their water consumption. (Source: Columbia Water Center)

It is important to acknowledge that there is a spectrum of quality – quantify interactions. Some water issues are purely quality related; this refers to water sources that are simply over-polluted as opposed to being over-used. Examples of this are seen in rivers in the Northeast US such as the Hudson and the Charles. In these cases, quality-oriented solutions are required. Other water quality problems have both quantity and quality components. The Ganges River in India, for example, is polluted by a range of biological, industrial and agricultural contaminants. The effect of these pollutants is greatly exacerbated by the decrease in quantity, resulting from overuse of the rivers flows. In this case, a mixture of quality and quantity oriented approached may be the most successful.

The question for water managers is when might a conservation based, quantity oriented approach help solve water quality problems? While certain factors need to be present for this sort of approach to be effective, I would argue that government officials, NGOs, local leaders – whoever stands to implement remedial steps – should not neglect the role of approaches which encourage conservation and focus on increasing quantity. When such an approach is tenable, it offers a low-cost solution that calls almost solely for behavioral change. In some cases, quantity-based solutions could replace historical – and often ineffective – pollution clean-up trends.

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