Two tales of a city to understand sustainability

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Just as there are two sides to every story, sustainability challenges have at least two stories to reach every solution. Scientists report new ways to understand and integrate those tales.

More than half of the people in the world live in cities. Understanding how cities can have enough water to sustain people, industries and the environment will mean integrating the stories of local struggles and successes with the sweeping narrative of how lands near and far are affected by water demands. Creating a system that combines both local and global is outlined in Oct. 12 edition of the journal *Ecology and Society*.

"There have been a lot of changes over time in the type of demand for water in cities," said a co-author, sustainability scientist Jianguo "Jack" Liu, director of Michigan State University's Center for Systems Integration and Sustainability (CSIS). "Cities have seen different users of water emerging as the economy has grown, and as understanding of environmental concerns has become more sophisticated. These changes have important implications for future water sustainability. Only understanding local challenges and solutions won't work, because what seems local in fact has global impacts. We need to design and deploy new ways to understand our world to prevent unintended consequences."

The international group of researchers show that aspects of major global sustainability problems are in danger of not being resolved - but only shifted without new ways to holistically track and understand the impact

of water policies.

The researchers dissect the water dynamics of Beijing, China's capital city with more than 20 million people, which shares many characteristics and challenges of other megacities - those with populations greater than 10 million. In "Urban Water Sustainability: Framework and Application," researchers note that by 2050 the world's urban areas with 6.3 billion people will need much more clean water to drink, cook and wash, as well as much more water to grow and produce food, generate power, support industry and maintain a healthy environment. Ways to handle those needs, however, are lagging, and water supplies already dwindling.

The scientists synthesize local events - such as changes in the source of Beijing's water supply—with the framework of telecoupling, which allows them to understand and predict socioeconomic and environmental interactions over distances.

That gives a way to look at some of Beijing's local events - such as their methods of controlling demand for water and how they've moved water-intensive industries like steel production out of the city - to not only understand those effects, but get a grip on how it's affecting places outside of Beijing.

For example, to receive more clean water from Hebei Province in the north, Beijing pays farmers in the province to plant corn instead of water-intensive rice to lower water use. When residents in the lower reaches complained about the dirty water discharges, Beijing issued new policies in 2014 to compensate for the polluted water it releases.

As both people and China's natural resources jostle for shrinking supplies of water, lead author Wu Yang, professor of environmental policy and sustainability at Zhejiang University in China and an alumnus

of CSIS said, achieving water sustainability is challenging and requires a holist approach considering both local human-water interactions and distant ones via trade, tourism, migration, and water diversion.

"This paper attempts to address such a challenge and extends the coupled human and natural systems approach to incorporate telecoupling processes," Yang said. "It also sets an example of how we may frame sustainability research and policy-making not only for water, but also for other environmental issues such as food and energy."

Already the reach beyond Beijing is being documented. The gargantuan pumping required to make the world's longest water transfer project, the South to North Water Transfer, a reality takes 51 pumping stations, including 278 pumping machines that consume that consume 529 megawatt energy per hour, to elevate water from the downstream Yangtze River to the North China Plain. And polluted water discharged from Beijing's increased consumption finds its way to oceans.

More information: Wu Yang et al, Urban water sustainability: framework and application, *Ecology and Society* (2016). DOI: 10.5751/ES-08685-210404

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