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Fresh Water Goes Global

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While water problems have been traditionally perceived, understood, and acted upon locally, recent progress in Earth system simulation, remote sensing, and analysis of water governance is producing novel perspectives on fresh water. The advances reveal previously unrecognized global forces driving local-scale problems. The stage is re-set for water research and policy.

LOCAL ACTION, GLOBAL CONCERN. Although water problems come best into focus locally, countless local stressors and impacts have accumulated to global significance (*1*). Regional water crises could also spill into the global domain should transboundary cooperation collapse in rivers like the Nile or Syr Darya (*2*), or sourcewaters fail in the Himalayan 'Third Pole', severing lifelines to 1B people (*3*). Water management even transcends fresh water itself, as when reservoirs trap riverborne sediment destined for the ocean, reducing the capacity of shorelines to withstand coastal erosion (*4*).

Fresh water is essential to human development. It is no surprise then that Amazonia, the Congo and Borneo are targeted for massive water engineering projects (*5*), yet protecting biodiversity in these ecosystems generates little conservation investment, even if its loss would be globally significant (*6*). Despite the importance of water to local prosperity, social fabric and the environment, the World Economic Forum declared water crises as the greatest collective risk to the global economy (*7*).

GLOBAL ACTION, LOCAL CONCERN. The sources of local water problems may not be as local as they seem. They are influenced by global mechanisms, primarily climate that controls the geography of water availability, and the world economy, which drives patterns of water use. These define the fundamental spatial and temporal character of water scarcity. Recent analysis of these patterns shows current usage already reaching maximum renewable global supplies (*8,9*).

Much of the world's water use and pollution is dedicated to production for global trade, which embodies impressive flows of *virtual water*. Such trade exacerbates local over-exploitation and provokes potential conflicts over water. It outsources environmental problems to countries with lax regulation that host highly polluting manufacturing or agriculture (*8*). Decisions on water infrastructure are made far from its ultimate point of installation or impact, and externalities largely remain unregulated (*10*).

GLOBAL GOVERNANCE FOR LOCAL STEWARDSHIP? Persistent water syndromes show local water governance unable to prevent impairment across much of the globe (*1*). At the same time, large-scale governance is no longer speculative, with many global actors (UN, banks, multinationals) and rules already in play, like the UN Watercourses and Ramsar conventions.

Nonetheless, large-scale governance has a near exclusive focus on transboundary surface waters (versus groundwater), pays scant attention to pollution, fails to reconcile mismatches between hydrologic units (river basins, aquifers) and administrative jurisdictions, and has few incentives for sustainable water use in a globalized economy (*10*). It is difficult to harmonize ownership, rights and access to water, and cultural norms across the international playing field. Nexus issues involving food, energy, and climate change are difficult to address because the linkages are essentially invisible, as with virtual water trade, which is regulated by trade agreements for commodities and not water.

Global water governance has yet to find its place among other scales of authority. Existing regimes remain legally fragmented and dominated by local and meso-scale solutions (*10*). Effective global governance requires clear guidelines and legal responsibilities so that consumers, governments, and investors reverse the current proliferation of free-riding, commodification of public goods, secret international contracts and arbitration, and environmental neglect. Without such, widespread damage and non-sustainable water use will remain the norm.

A GLOBAL TEST CASE. An example of comprehensive water planning is unfolding in the intergovernmental arena with the post-2015 Sustainable Development Goals (SDGs) (*11*), which build on the earlier Millennium Development Goals (MDGs). While MDG outcomes have been mixed (the drinking water target for the poor attained ahead of schedule, but delayed for sanitation (*12*)), they served as an important motivator for member states to prioritize their water development efforts. SDGs expand the MDG agenda that focused on the poor to now include developing and developed world alike. Current SDG water proposals seek ecosystem protection, limits to pollution, and early responses to water-related hazards.

Such comprehensive SDGs should lead to converging national policies, but if they actually do so remains an open question. Technical capacity still focuses on local-scale solutions that fail to recognize broader-scale realities, like the connectivity of water systems. Thus, while sewering a developing world city improves the lot of urban dwellers, failure to install wastewater treatment destroys aquatic biodiversity and elevates health risks and water treatment costs downstream. Since 80% of today's sewage is discharged untreated (*11*), the issue is far from theoretical. Absent commitments to avoid the status quo, water systems will require substantial rehabilitation, nearly always much more costly than problem prevention, and miss opportunities to apply new ecosystem-based approaches (*1*).

Despite their significance, the water-related SDGs alone will be unable to effect a transition to global governance and resilient solutions. International trade agreements need to be supplemented with context-specific but universally agreed-upon rules and

standards on sustainable water use, water quality and environmental flows. Principles like polluter/user pays and equitable water sharing are universal and key to avoiding perverse incentives that have historically externalized impacts.

The global perspective is essential, but not a panacea. It may be counter-productive should it obscure, devalue or fail to reflect the unique character of local or national settings. Experience shows that effective implementation of global measures is contingent on political will, robust design and institutional capacity.

In conclusion, acknowledging that local actions on water have accumulated to global syndromes is a necessary first step to reaching effective governance. A global perspective is essential for providing context to local conditions, helping to recognize commonalities in both problems and best practice solutions, identifying places where prevention or remediation is needed most, and systematically tracking progress or backsliding. In this way, global thinking will help in formulating international agreements on water stewardship that ensure social equity and sustainability. Persistent focus on the local scale will miss such opportunities, which could otherwise make meaningful progress in solving 21st century water problems that are, in fact, global problems.

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