Fresh Water Futures:
Imagining Responses to Demand Growth, Climate Change, and the Politics of Water Resource Management by 2040

Prepared by

The Stimson Center

May 2010

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Scope Note

On 29 January 2010, The Stimson Center, under the sponsorship of the National Intelligence Council and the US State Department, organized a workshop in Washington, DC, focused on the future of global fresh water resources and the politics of water resource management. The conference brought together more than forty policy practitioners and analysts drawn from government, academia, intergovernmental organizations, NGOs, and research institutions in the United States and abroad. Over the course of the day, the assembled experts examined environmental, institutional, and socio-economic trends affecting surface and groundwater supplies in selected regions and assessed dynamics that could contribute to political conflict, perturb regional power relations, or pose humanitarian concerns warranting external engagement.

Specific in-country cases included Yemen and Afghanistan, and transboundary cases included the river basins of the Mekong, Ganges, Mahakali, and Indus rivers.

Building on this base, the workshop then considered criteria for identifying basins where future tensions or instabilities could emerge and assessed the roles that technological innovations, market mechanisms, river basin institutions, and other policy approaches play in the cooperative management of shared water resources.

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Executive Summary

Existing interstate relationships, evolving demographic trends, economic growth, climate change, and human efforts to manage fresh water availability will determine the quantity and quality of available water supplies in the coming decades. The interplay of these factors make water availability both a human security and national security issue.

- Some 70 percent of the earth's surface is covered by oceans. On the less than 30 percent covered by land, more than 84 percent of the world's population lives on the driest half. Humans extensively re-engineer the global hydrological system, erecting dams, drilling wells, creating irrigation systems, and other water works.
- This infrastructure ensures water supplies for human consumption, sanitation, agriculture, industry, energy production, and other uses. ***In many cases such interventions are proving unsustainable in the long run, exhausting underground aquifers and interrupting sediment flows and nutrient cycles in surface waters, among other repercussions.***

The world's 263 international watersheds encompass half of the global population and cover 60 percent of the planet's surface. ***Water and resource stresses interact with a host of other factors adding to the risk of conflict. People, groups, and countries rarely fight over these resources directly, but resource stress causes various forms of social dislocation that make violence more likely.***

- One academic survey of international interactions over water indicates that cooperation predominates over conflict. Other researchers challenge that conclusion, observing cooperation and conflict actually co-exist with not all conflict necessarily bad and not all cooperation necessarily good. If the question is rephrased as to whether there is *any* connection between fresh water and conflict, including violent conflict, in selected cases the answer is "yes."
- Other researchers note that roles of states often determine the nature and pace of transboundary water discussions and any outcomes, agreements, or legal frameworks that emerge. The chance of conflict increases at lower, sub-national scales, and frictions at local levels may spark larger conflagrations.

Governing institutions in the developing world often fail to understand water challenges or make the necessary difficult political and economic decisions to correct deficiencies in water quality and quantity for human consumption, agriculture, or industry. Water planners frequently lack adequate, accurate data for effective policymaking. Knowledge of water balances in specific tributaries, replenishment rates for shared aquifers, or water demands in particular communities may be either unavailable or scattered among multiple entities across multiple countries. Similarly, responsibilities for different aspects of climate, water, and development policies are typically divided, with different institutions and authorities serving different constituencies and objectives. ***Such institutions are often not trusted by the population as many view state agencies as alien or corrupt.***

- In Yemen, the state faces multiple crises. The government does not control the whole country and state authority is increasingly in question. Sanaa may become the first capital in modern history to run out of water. The country possesses neither adequate infrastructure for delivering water nor effective legal structures for regulating its use. While the city population grows by over 7 percent annually, the water table is dropping by several meters per year as groundwater is extracted at four times the replenishment rate. ***At present, the government has no coherent plans for curbing water demand or developing alternative supplies and water shortages are reportedly starting to cause civil unrest.***

- ***In Afghanistan, 80 percent of the people depend on natural resources for their livelihood. In Helmand province most of the population lives close to the Helmand River.*** Many traditional systems of water management have been disrupted by thirty years of war. ***Ongoing drought has lead to increasing reliance on groundwater, but these sources are frequently tainted by cross-contamination from leaking septic tanks, oil storage, and other wastes.*** Reconstruction efforts, humanitarian assistance, and the return of refugees to the region require supplying water for sanitation, agriculture, and livestock. Yet there is very little information available to establish local water budgets. There is no water gauging in Afghanistan, little knowledge of aquifer recharge rates, very sparse data on water quality, and combat conditions make it extremely difficult to collect data.

Most transboundary water conflicts arise not over natural supplies but over human interventions to manage them. Dams, irrigation diversions, and other infrastructure alter both hydrological relations, affecting the quantity, quality, and timing of downriver flows, but also relations between upstream and downstream riparians.

- The Mekong exemplifies this dynamic.[1] Hydropower dams under construction or under consideration in Cambodia, Laos, and China, while boosting development prospects in some respects, threaten to disrupt the region's ecological balance and will block the flow of sediments and nutrients downstream to nourish the delta, a crucial source of rice for Vietnam and the surrounding region. They will also block the migration of fish upstream in a river that accounts for one fifth of the world's freshwater catch. The series of dams underway in China is particularly worrisome as they will effectively position China to regulate the river's seasonal flow, with uncertain environmental and political ramifications. The Mekong River Commission provides a potential forum for addressing some of these issues, but China holds only observer status.

The management of transboundary water resources takes place across a range of scales from the local to the global system, but water treaties often lack sufficient specificity or resolution mechanisms to avoid tensions between states. Further, international law in general is vague, often contradictory, and does not demand standards.

- In South Asia, three distinct treaties cover the Indus, the Ganges, and the Mahakali rivers. The three agreements adopt very different approaches. The Indus accord physically shares the basin, giving the three western branches of the river to Pakistan and the three eastern branches to India. The Ganges Treaty shares the river water between India and Bangladesh. It stipulates how much water each party should receive each ten days during the yearly wet season between 1 January and 31 May. The Mahakali Treaty was supposed to share development of the river, but the intended common project between India and Nepal has not yet been built or even designed. Of the three agreements, only the Ganges accord makes explicit provisions for substantial shortfalls in river flow of the kind that climate change

[1] At present the situation in the Mekong is complicated by a severe drought.

might engender. Though it calls on the parties to consult, it does not specify how they should resolve the issue.

- Despite their different forms, the three treaties bear out the general dependence of water politics on the surrounding political picture, as the degree of conflict or comity on each river at any given time has typically reflected the overall tenor of relations between India and its neighbors. Experience with the Indus Treaty illuminates how international tensions are shaped and aggravated by domestic ones, and shows how water policy solutions can be generated that link and ameliorate local, regional, and global tensions.

Rapidly growing cities constitute major centers of water demand for sanitation, industry, and hydroelectric power. Cities can also constitute major sources of water loss and waste, with leakage rates reaching 30-50 percent.[2] Yet cities rarely figure in integrated international planning.

- Workshop participants observed that a multi-dimensional approach to water management—combining policy, water systems design, and environmental considerations—offers an approach for integrating management alternatives across political boundaries. Appropriate strategies for urban planning, infrastructure repair, development of green buildings, rainwater harvesting, etc., could realize substantial efficiencies, diminishing the pressures on shared transboundary water resources.

The private sector, too, increasingly worries about the availability of water resources, the politics of access, and the kinds and quantity of investments needed to ensure sustainable future supplies. A recent study showed that extrapolations from present water demand growth trends compared with sustainable water supplies indicate a global gap of 40 percent in 2030, with over one-third of the world's population living in basins where the deficit will be larger than 50 percent.

- In India, for example, projected future agricultural water consumption alone is equal to all of that country's utilizable water in 2030. Despite these trends, the study also indicated that solutions are available if states act early and consider a spectrum of strategies—from efficiency improvements to productivity increases, to R & D investment and technological innovations. Actions could also include the "virtual" importing of water done as part of food or industrial process in parts of the world where water is more abundant. Many steps that could be taken would show cost savings; the fact these have not been acted upon suggest more efficient water management is impeded by other policy obstacles (e.g., subsidies to water withdrawals or lack of water-sharing arrangements) or deliberate policy choices (decisions to maximize water use to establish water rights or grow crops domestically for food security rather than import).

Some experts note that water scarcity may provide an indirect spur to social instability if, for example, it pushes water-stressed rural populations from struggling farms toward the cities. Other experts wonder about the social ramifications of water policies that reduce agricultural demand for water—for example, increasing imports, switching crop varieties, etc.—but result in reduced agricultural demand for labor, again pushing rural populations toward the cities. ***Indeed, violent water clashes, such as the strikes and riots that frequently accompany the privatization***

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[2] For reference, 25-30 percent leakage is not uncommon for older US cities (ie., Detroit, Philadelphia); hydrologists consider leakage of 15 percent as normal or good.

of water services, increasingly stem not from scarcity per se but from policies intended to address scarcity. Ultimately, many of the participants argue that ensuring water security must be placed in its human security context, and concerns about potential water scarcity conflicts flaring in the decades ahead must not overshadow the requirement to address the pressing needs of deprived populations living without adequate water supplies and sanitation today. Water security concerns shape political behavior and interact with broader security concerns, meaning water security cannot simply be a question of lives lost or wars fought.

Contents

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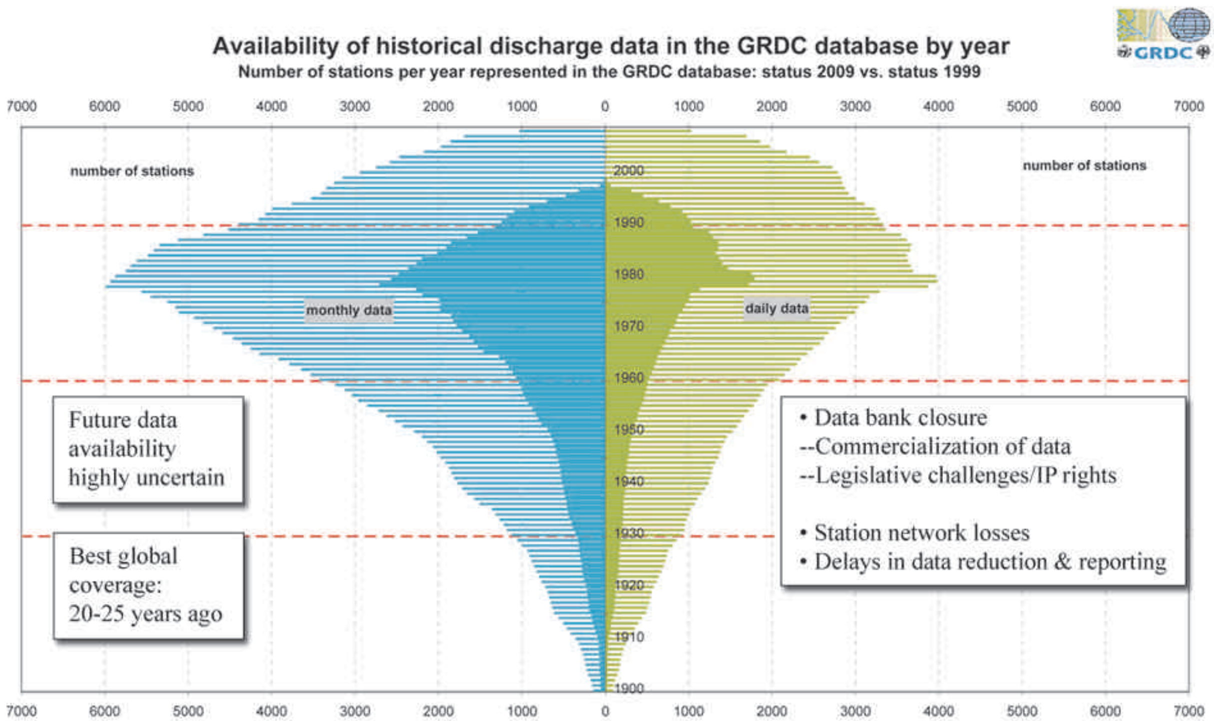
Discussion

Background

Some 70 percent of the earth's surface is covered by oceans. On the less than 30 percent covered by land, more than 84 percent of the world's population lives on the driest half. To make up for this imbalance, humans have extensively re-engineered the global hydrological system, erecting dams, drilling wells, creating irrigation systems, and other water works. This infrastructure ensures water supplies for human consumption, sanitation, agriculture, industry, energy production, and other uses. But in many cases such interventions are also proving unsustainable in the long run, exhausting underground aquifers and interrupting sediment flows and nutrient cycles in surface waters, among other repercussions. How these impacts in turn interact with evolving demographic trends, economic growth, and climate change will substantially determine water demand and the quantity and quality of available water supplies in the coming decades.

The socio-economic forces and environmental pressures that will shape the water future operate at multiple spatial and temporal scales. But while hydrological systems ignore political boundaries, policy makers do not. Policy makers typically articulate water planning as a place-based issue. Yet the amount of ground-level information on local and regional water balances that is made freely available to the global assessment community through the UN-designated repository (WMO Global Runoff Data Center [Koblenz, Germany]), has in fact fallen dramatically in recent years. In some areas, such as Africa, monitoring capacity has been lost. In others, water agencies no longer freely report observations from their stream gauges, requiring cost-recovery rather than releasing the data to global public archives. Consequently, water managers hold less information from ground-based stations today than in the 1980s.

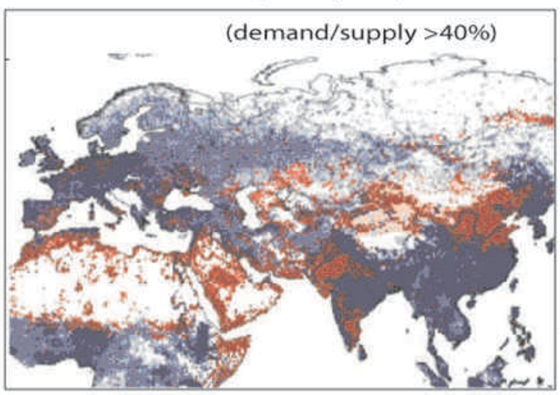
Technological developments such as remote-sensing imagery and model simulations can offset some of these shortfalls. By utilizing geographical information system (GIS) techniques to combine selected geophysical and social science datasets, analysts can create detailed maps charting water scarcity at much higher spatial resolution than aggregated national assessments that can mask local variations. In this way, one recent evaluation effectively tripled estimates of the number of people living in conditions of severe water stress, compared to a previous 1997 UN country-level survey. Similarly, NASA and the European Space Agency are currently cooperating on a satellite surface water topography monitoring system that could detect the waxing and waning of river flows to within 10-20 percent accuracy. Such systems are extremely costly—ten times more expensive than comparable ground-based instrumentation—and short-lived, lasting only the 3-5 years that the satellites remain in orbit. Moreover, as several participants note, satellites do not simply replace stream gauges, as it is still necessary to collect observations *in situ* to validate the readings obtained by remote sensing. Nevertheless, GIS frameworks provide an increasingly valuable tool for policy diagnosis and design.

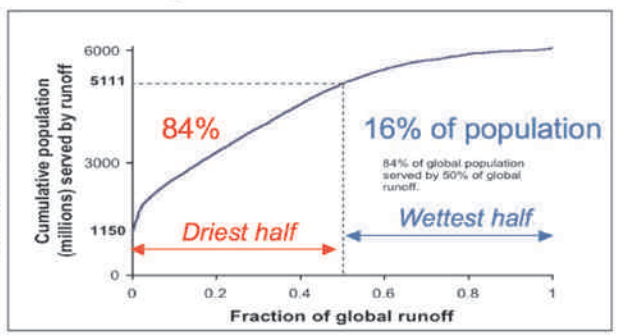


Courtesy of Global Runoff Data Centre (GRDC) in the Bundesanstalt für Gewässerkunde (BfG), Koblenz, 2010. (U)

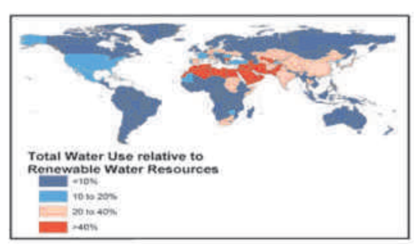
In the last 10 years: New Geospatial Approaches Raise Estimates of Scarcity

Contemporary Population under Growing Water Stress



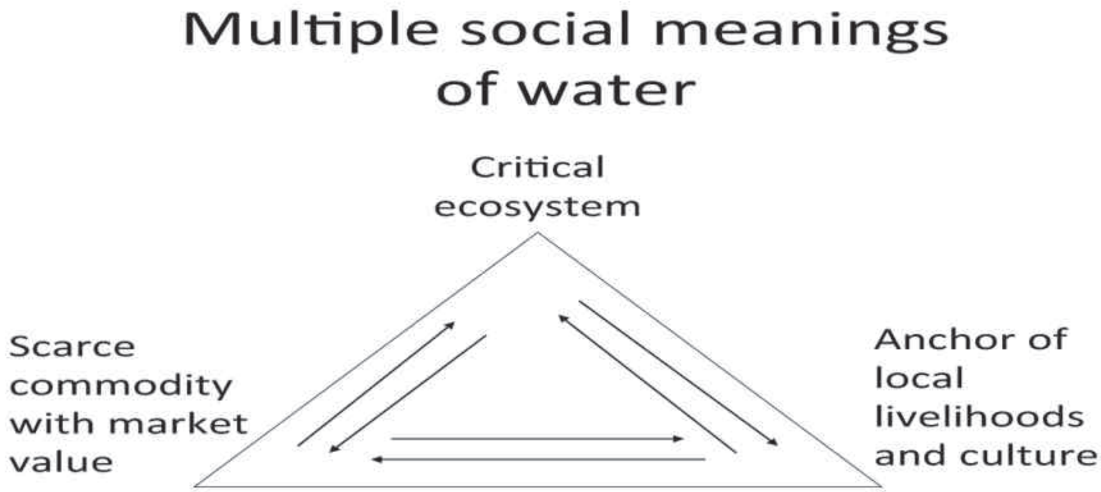


Water Stress	DIA/Q (unitless)	Total Population (billions): Country-level U.N.	Country-level Grid Sum	Grid-based Full Resolution
Low	*<0.1*	1.72	1.95	3.16
Moderate	*0.1 to 0.2*	2.08	1.73	0.38
Med-high	*0.2 to 0.4*	1.44	1.54	0.37
High	*>0.4*	0.46	0.45	1.76



Source: Charles J. Vorosmarty, Pamela Green, Joseph Salisbury, Richard B. Lammers, "Global Water Resources: Vulnerability from Climate Change and Population Growth" Science 289, no. 5477 (2000). (U)

Water has myriad competing uses. It is an element of ecosystems, a foundation of livelihoods, a commodity of value, and an anchor of cultural meaning. Social conflict surrounding these contending water demands is inherent, endemic, and pervasive, though not necessarily violent. Institutions are one means by which societies seek to manage, if not definitively resolve these allocation challenges.



Adapted from: Ken Conca, Governing Water: Contentious Transnational Politics and Global Institution Building (Cambridge, MA: MIT Press, 2006) (U)

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Courtesy: Ken Conca

Just as multiple and varied human and environmental factors drive water supply and demand, so multiple and heterogeneous institutions influence how humans use and manage water. They comprise informal social roles, norms, and practices as well as formal rules and organizations. These institutions are themselves undergoing dynamic change as new technologies develop, new policy objectives emerge, and regulatory regimes evolve. Climate change, land use trends, demographic pressures, and economic expansion thus weigh on a water management system that is already in flux.

Within Boundary Cases: Yemen and Afghanistan

Water stress can exacerbate instabilities in weak or failing states. In Yemen, the state faces multiple crises. The government does not control the whole country and state authority is increasingly in question. At the same time, Sanaa may become the first capital in modern history to run out of water. The country possesses neither adequate infrastructure for delivering water nor effective legal structures for regulating its use. While the city population grows by over 7 percent annually, the water table is also dropping by several meters per year as groundwater is extracted at four times the replenishment rate. Some in government speak of relocating the capital. Yet water simply has not been a government priority, despite increasing scarcity. Only in 2005 was the water ministry created.

Some workshop participants note that predictions of impending water crisis in Yemen date back decades, yet Sanaa has not run out of water. Rather, as demand collides with supply, consumers adapt, as Israel did, for example, when it "ran out of water" in the 1970s. Other participants, however, question the extent of Yemen's adaptive capacities. There is little sign that increasing water pressure is inducing more efficient water use. On the contrary, the government continues to subsidize diesel fuel to power pumps drawing groundwater for irrigation, and farmers are increasingly cultivating qat (also spelled khat), a mild narcotic for domestic consumption that yields larger crops the more water it is given. Some estimates suggest that 40-70 percent of the water in Yemen is for qat cultivation. Changing incentives away from qat cultivation will be extremely difficult and could be destabilizing as it is a highly lucrative crop and ingrained in Yemeni culture. Qat leaves can be harvested up to four times a year. At present, the government has no coherent plans for curbing water demand or developing alternative supplies.

Israel shifted agricultural production away from grains and other water intensive crops and instead imported these crops from water-abundant nations. This probably is not a viable strategy for most water-poor, developing countries. As an early adopter of this policy and an advanced economy Israel had the resources and ability to export other capital-intensive products to purchase these agricultural products high in "virtual water." As more countries adopt this policy increased competition for exported agricultural products with high "virtual water" content will increase the price of those imports, disadvantaging developing countries.

In Afghanistan, 80 percent of the people depend on natural resources for their livelihood. If those resources fail, livelihoods falter, and people move to the cities seeking jobs. Helmand province represents a particularly important region for US policy. The province is located in the dry southeast of the country, and most of the population lives close to the Helmand River. Many traditional systems of water management have been disrupted by thirty years of war. Ongoing drought has lead to increasing reliance on groundwater, but these sources are frequently tainted by cross-contamination from leaking septic tanks, oil storage, and other wastes. Reconstruction efforts, humanitarian assistance, and the return of refugees to the region require supplying water for sanitation, agriculture, and livestock. Yet there is very little information available to establish local water budgets. There is no water gauging in Afghanistan, little knowledge of aquifer recharge rates, very sparse data on water quality, and combat conditions make it extremely difficult to collect data on the ground.

The United States is exploring possibilities for developing agriculture and hydropower in Helmand province, but has not so far considered the potential impacts such projects might entail for Iran, the downstream riparian. From Afghanistan, the Helmand River flows into Baluchistan, a region that is both Iran's breadbasket and home to an internal Sunni insurgency. Iran currently consumes 80 percent of the water from the Helmand and regards water projects in Afghanistan as potential threats to its security. In at least one instance, explosives have been found on a dam in Afghanistan and linked back to Iran. Nevertheless, the two countries share a long, if inconclusive, history of negotiations over the Helmand, and Iran appears eager to reach a more lasting settlement. US science diplomacy could help foster such an agreement and might provide a framework for deeper practical engagement with Iran. America's National Academies, the NIH, and a number of conservation organizations already collaborate fruitfully with Iranian counterparts, and Iran has said that it would welcome US technical mediation on the Helmand.

A Multi-Scale Approach

- Paucity of current information on in-stream flow
    - USGS Data for the most of Afghanistan is 30 years old
    - Needs to be updated to gain accurate information on current water budget
        - New gauging stations planned with World Bank/Asian Development Bank assistance
- Sparse data collection of groundwater levels
    - Groundwater levels drawn down as a result of the drought and overdraft
    - Recharge rate of the aquifers needs to be understood and monitored
- Finally, data about water quality are even more difficult to come by
    - Little information in the literature, most reports observational
    - Comprehensive assessment of watershed quality is missing

Open sewer in District 5 of Kabul

Well in Mazar-e-Sharif Civil Hospital filled with medical wastes.

Text Source: Palmer-Moloney, L.J., B. Graff, D. Voyadgis, J. Young, and F. R. Griggs, (2010). Gauging Water Security & Scarcity in Southwest Afghanistan: "A Cultural, Geographic, and Environmental Perspective on Afghanistan's Helmand River Watershed. Retrieved from the RCU PAKAF Data Library .

Image Source: UNEP, "Afghanistan: Post-Conflict Environmental Assessment," January 2003, p32, 40.

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Nations such as Yemen and Afghanistan pose extremely challenging environments for policy efforts to improve water management and ensure sustainable freshwater supplies for the future. It is not clear how governing institutions can address these problems when much of the population does not trust the state, and many view state agencies as alien or corrupt. Nor is it clear how Integrated Water Resource Management (IWRM) approaches that might be highly effective, but that are also highly information intensive, can be applied in locations where accurate data is almost entirely lacking. Some experience from Afghanistan suggests that otherwise reluctant stakeholders may work together on data collection under some circumstances. Local imams, for instance, have contributed to building local acceptance of water monitoring by helping explain that water quality relates to public health. Whether such cooperation can spill over into broader policy collaboration remains an open question. Several participants remarked that technical information often does not play as large a role in decision making as scientific experts might wish; policy decisions are frequently made on political grounds.

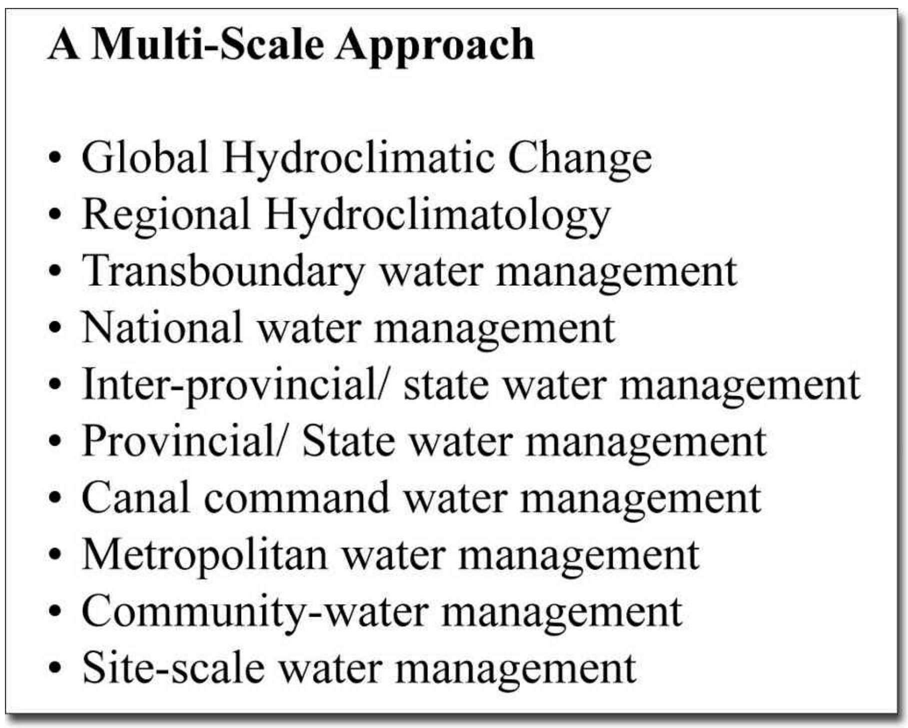
Transboundary Cases: the Mekong, Ganges, Mahakali, and Indus

Most transboundary water conflicts arise not over natural supplies but over human interventions to manage them. Dams, irrigation diversions, and other infrastructure alter both hydrological relations—affecting the quantity, quality, and timing of downriver flows—but also power relations between upstream and downstream riparians. The Mekong exemplifies this dynamic. Hydropower dams under construction or under consideration in Cambodia, Laos, and China threaten to disrupt the river's ecological balance. These dams will block the flow of sediments and nutrients downstream to nourish the delta, a crucial source of rice for Vietnam and the surrounding region. They will also block the migration of fish upstream in a river that accounts for one fifth of the world's freshwater catch. The series of dams underway in China is particularly worrisome. The vast reservoirs that these dams will impound in the Mekong's upper reaches effectively position China to regulate the river's seasonal flow, with uncertain environmental and political ramifications. The Mekong River Commission provides a potential forum for addressing some of these issues, but China is not a member, holding only observer status.

Water relations between India and its neighbors—and transboundary relations between states within India—also illustrate the influence of water projects on water policy. Among its key provisions, the 1960 Indus Treaty with Pakistan regulates certain technical features of engineering projects that India can undertake on tributaries lying in its territory. The origins of the 1996 Ganges Treaty between India and Bangladesh can be traced to India's construction of the Farakka barrage. Similarly, the 1996 treaty with Nepal concerning the Mahakali centers on a cooperative river development project. The three agreements adopt very different approaches, however. The Indus accord physically shares the basin, giving the three western branches of the river to Pakistan and the three eastern branches to India. The Ganges Treaty shares the river water. It stipulates how much water each party should receive each ten days during the yearly wet season between 1 January and 31 May. The Mahakali Treaty was supposed to share development of the river, but the intended common project has not yet been built or even designed. Of the three agreements, only the Ganges accord makes explicit provisions for substantial shortfalls in river flow of the kind that climate change might engender. Though it calls on the parties to consult, the treaty does not specify how they should resolve the issue. Despite their different forms, the three treaties bear out the general dependence of water politics on the surrounding political picture, as the degree of conflict or comity on each river at any given time has typically reflected the overall tenor of relations between India and her neighbors.

An examination of the Indus Treaty illustrates how international tensions are shaped and aggravated by domestic ones. It likewise shows how water policy solutions can be generated that link and ameliorate local, regional, and global tensions. The management of transboundary water resources takes place across a range of scales from the local to the global system. In Pakistan, for example, the Indus—where all the major headwaters lie in India—waters the largest continuous irrigated area in the world; any local site placing a demand for water resides within a province, within the nation, within the international basin, and water available is influence by continental and global processes such as the monsoon.

A multi-dimensional approach to water management—combining policy, water systems design, and environmental considerations—offers an approach for integrating management alternatives across political boundaries. Rapidly growing cities constitute major centers of water demand for sanitation, industry, and hydroelectric power. Cities can also constitute major sources of water loss and waste, with leakage rates reaching 30-50 percent. Yet cities rarely figure in integrated international planning. Appropriate strategies for urban planning, infrastructure repair, development of green buildings, rainwater harvesting, etc., could realize substantial efficiencies, diminishing the pressures on shared transboundary water resources.

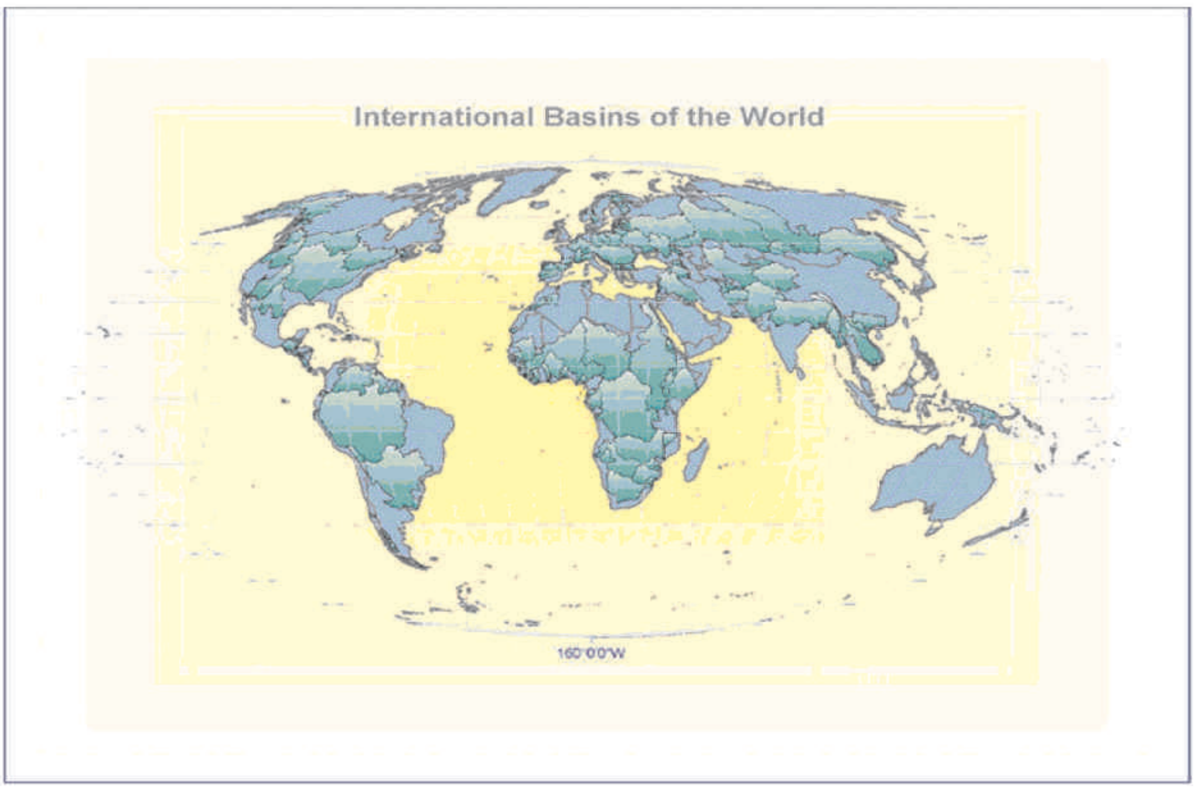


Courtesy: James Wescoat (U)

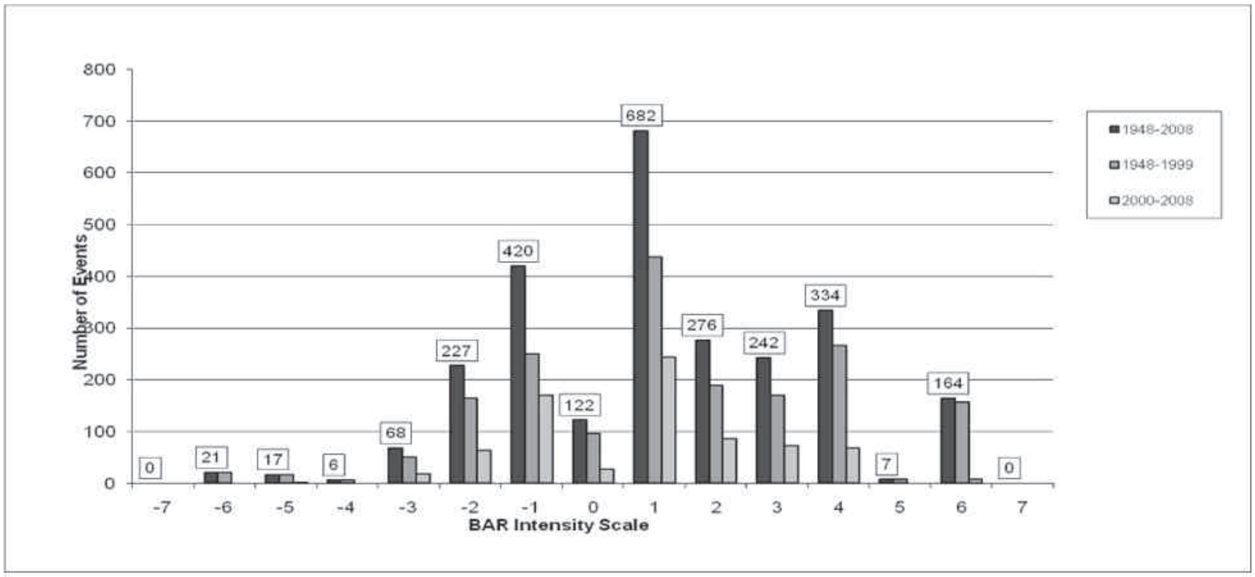
Participants observed it is critical for policy makers to think across national and institutional boundaries if they are to adequately prepare for growing relations of interdependence. Neither administrative jurisdictions nor bureaucratic remits correspond to ecological zones or environmental functions. Developed water policy must be resilient and accommodate the fact that water resources are never fixed. Water is always part of the hydrological cycle—including groundwater, surface water, soil moisture, and atmospheric moisture—and part of an ecosystem from which it is diverted or withdrawn. To manage water is also to manage associated uses such as agriculture or energy, and the different development paths that will make contending claims on water supplies and institutions. Emerging stresses such as climate change will highlight these interdependencies and potential conflicts; hydropower, for instance can reduce greenhouse emissions but has important ramifications for fisheries and farming. As such, policy makers must develop holistic approaches to managing shared water resources, integrating the needs of different users while taking actions to preserve the sustainability of ecosystems, both of which will change over time.

Identifying Basins at Risk and Potential Solutions

The world's 263 international watersheds encompass half of the global population and cover 60 percent of the planet's surface. To understand the potential for future conflict and possibilities for peaceful development in these basins requires studying them systematically. A global survey of international interactions over water reveals that cooperation predominates over conflict. There has been little interstate violence and no wars over water in the past half-century. The chance of conflict increases at lower, sub-national scales, however, and frictions at local levels may spark larger conflagrations.



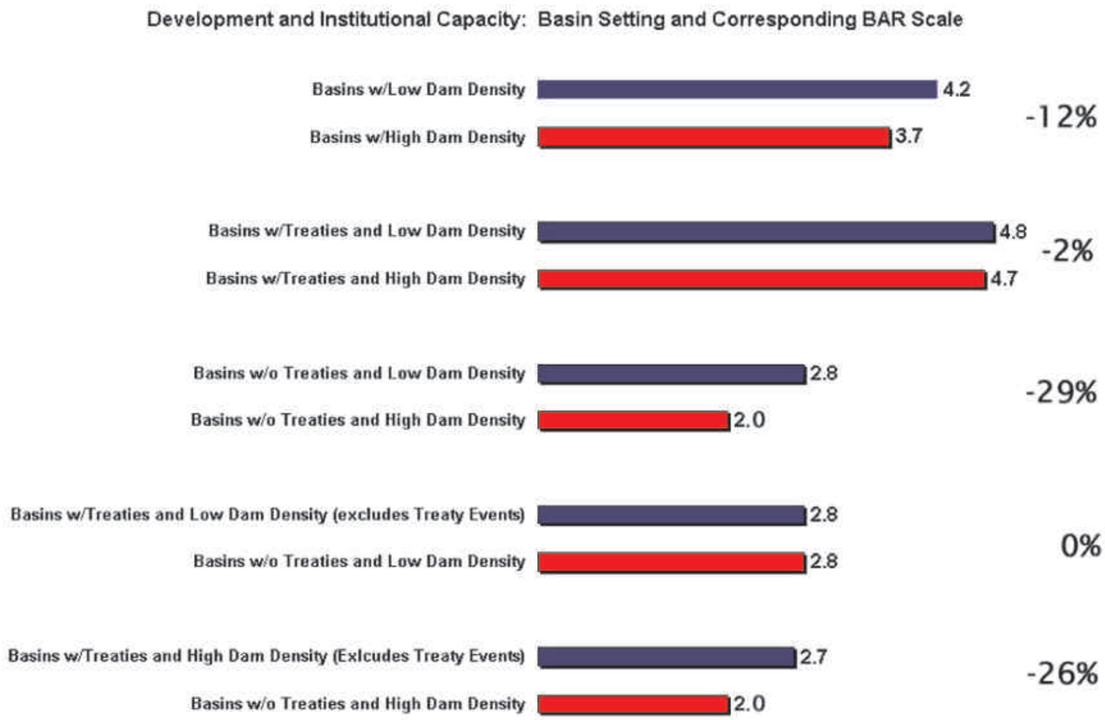
Source: The Transboundary Freshwater Dispute Database, Program in Water Conflict Management and Transformation, Oregon State University. (U)



Source: The Transboundary Freshwater Dispute Database, Program in Water Conflict Management and Transformation, Oregon State University. (U)

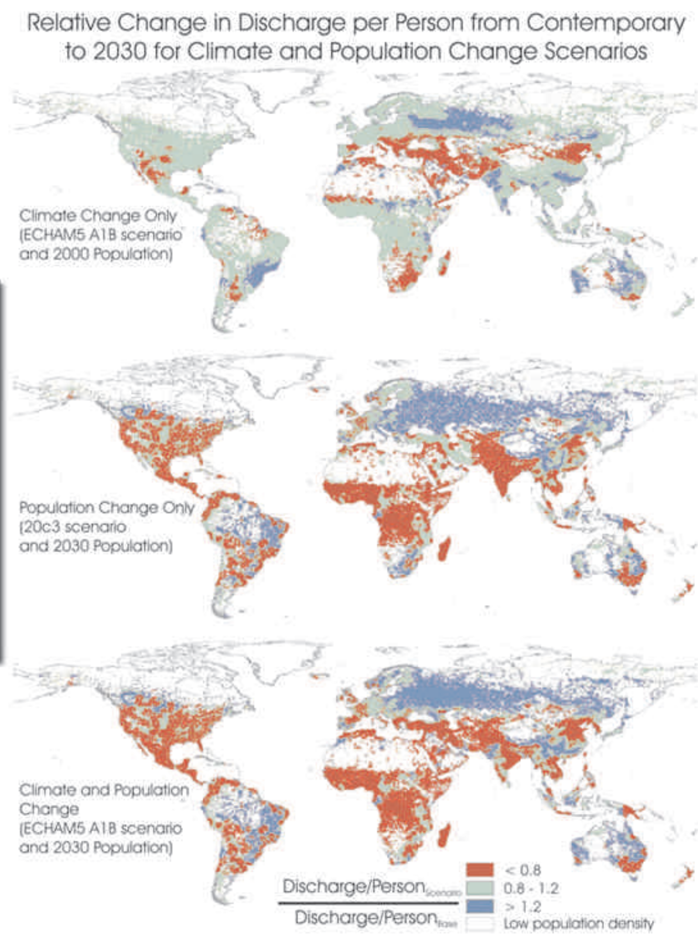
Between nations, the likelihood of conflict rises as the rate of physical/environmental change exceeds institutional capacities to absorb or alleviate that change. So, for instance, construction of a dam may significantly shift water availability. Statistically, the likelihood of conflictual interactions over water appears slightly higher in areas of high dam density. But this propensity disappears where institutional arrangements such as treaties or river commissions exist to mitigate these pressures.

Population growth and poverty are the key drivers of change in the world's water systems, propelling rising demand. Climate change will exacerbate these pressures, likely adding to the variability and rate of change experienced in individual basins. Unfortunately, these combined indicators suggest that physical pressures on water resources may be the greatest and institutional coping capacities the least in basins where they are needed the most, such as the rivers flowing from the Himalayas that supply the rising populations of China and South Asia.

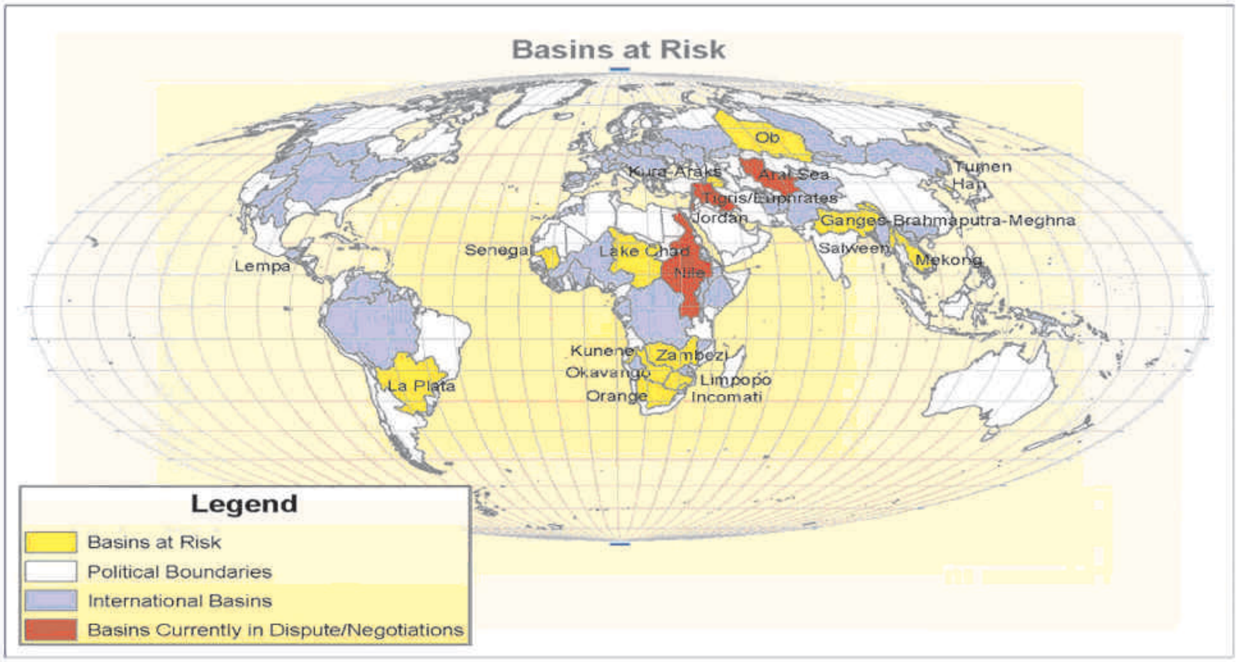


Source: The Transboundary Freshwater Dispute Database, Program in Water Conflict Management and Transformation, Oregon State University. (U)

- Climate Change only part of our water resource worries
- Population growth and economic development another critical issue



Source: Center for International Earth Science Information Network, "Assessment of Climate Change Impacts on Select U.S. Security Interests: Module 3: Water Scarcity," Columbia University for the National Intelligence Council, November 20, 2007. (U)

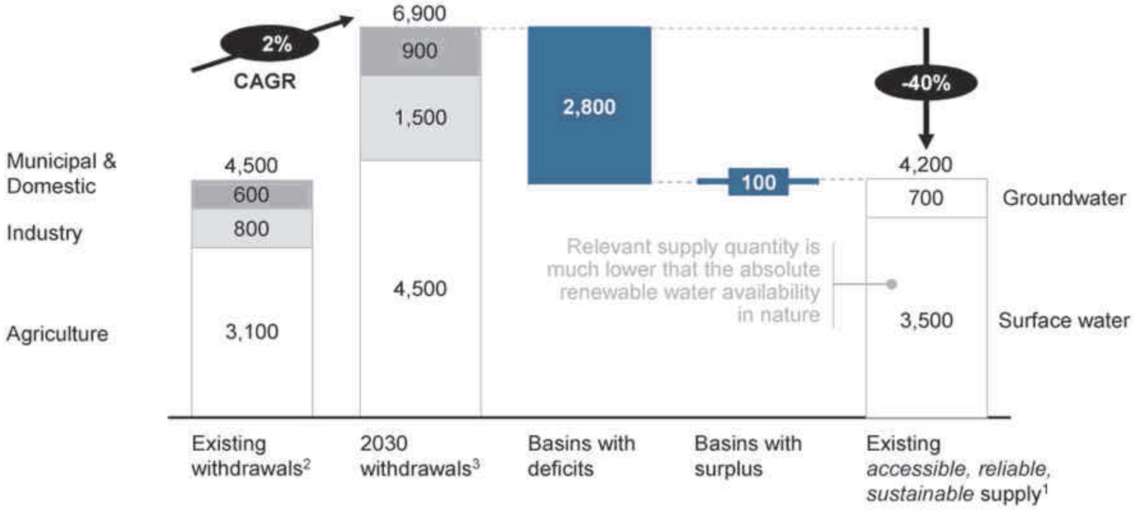


Source: The Transboundary Freshwater Dispute Database, Program in Water Conflict Management and Transformation, Oregon State University. (U)

The private sector, too, increasingly worries about the availability of water resources, the politics of access, and the kinds and quantity of investments needed to ensure sustainable future supplies. A recent study by McKinsey, in partnership with the International Finance Corporation (IFC) and a business consortium, illuminates one approach to defining the issues and identifying possible solution sets in terms that engage both the private sector and public policy. To frame the challenge, extrapolating from present demand growth trends to compare future withdrawals with sustainable supplies yields an implied global gap of –40 percent in 2030, with over one-third of the world's population living under water scarcity. In India, for example, anticipated agricultural demands for water alone are equal to all of that country's utilizable water in 2030.

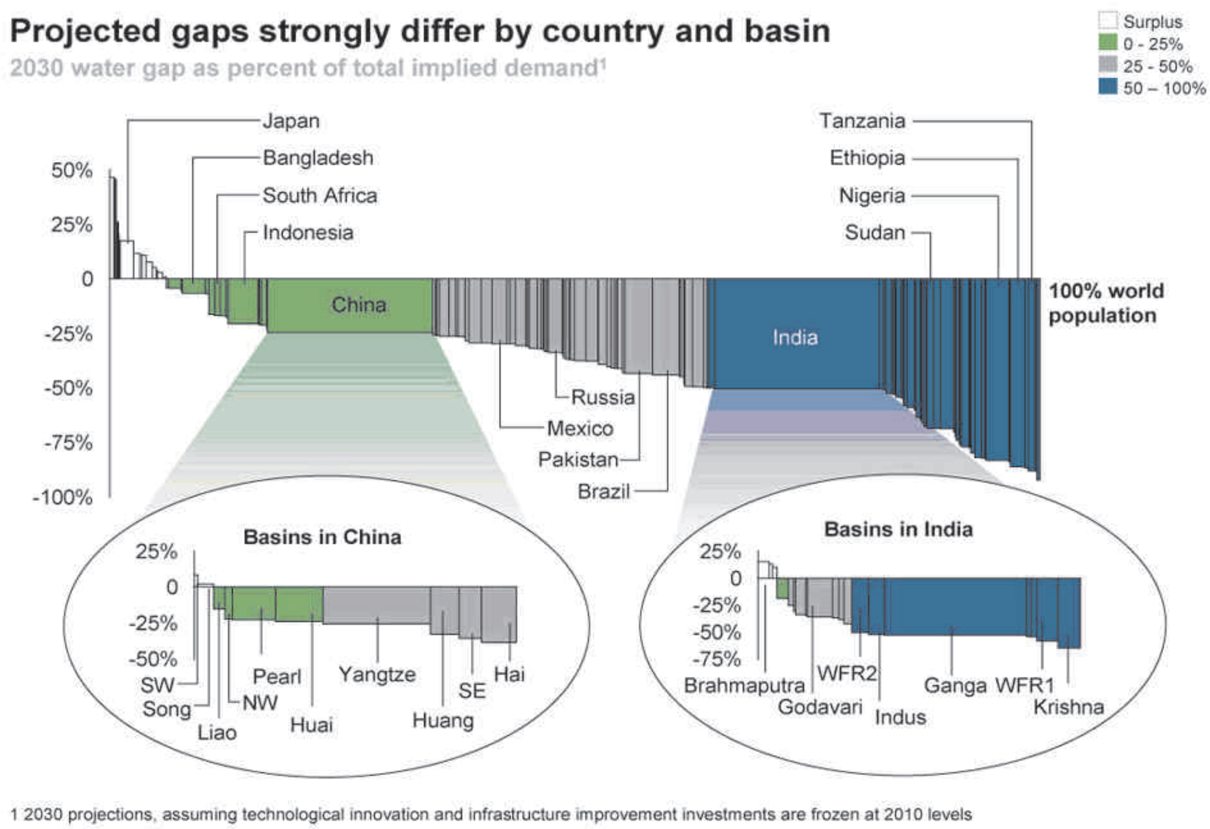
Future demand for water will outstrip our capacity[1] to provide it

Billion m³, 154 basins/regions



1 Existing supply which can be provided at 90% reliability, based on historical hydrology and infrastructure investments scheduled through 2010; net of environmental requirements
2 Based on 2010 agricultural production analyses from IFPRI
3 Based on GDP, population projections and agricultural production projections from IFPRI; considers no water productivity gains between 2005-2030

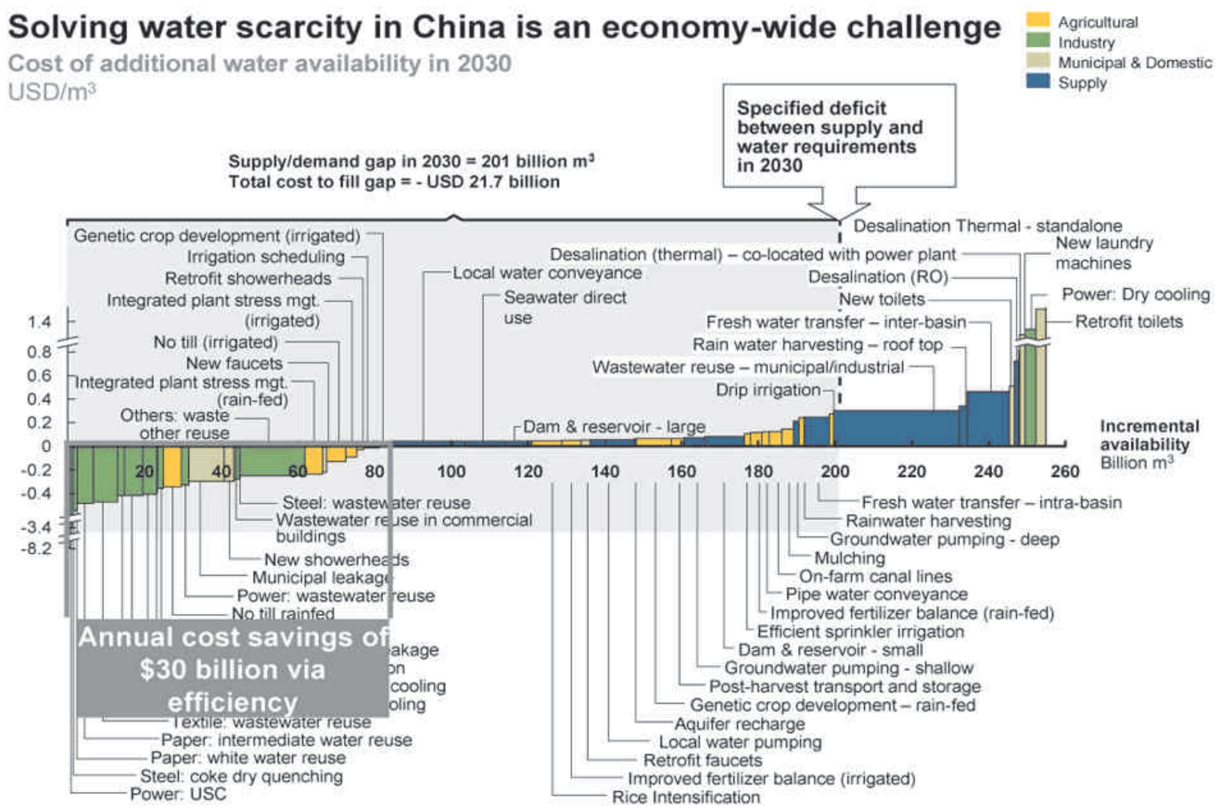
Source: 2030 Water Resources Group, "Charting Our Water Future: Economic frameworks to inform decision-making", McKinsey & Company 2009, p.6. (U)



2030 Water Resources Group, "Charting Our Water Future: Economic frameworks to inform decision-making", McKinsey & Company 2009, p.49. (U)

Greater efficiency will redress some of this imbalance, but historical rates of efficiency improvement will not suffice to close the gap. The McKinsey model provides a fine-grained, sectoral breakdown across a spectrum of strategies—from efficiency improvements to productivity increases, to R & D investment and technological innovations—indicating to policy makers how much water can be gained from each measure and at what cost. Tellingly, many steps can be taken at outright cost savings but have not so far been enacted. China now loses $30 billion annually this way. These results suggest that other policy obstacles (e.g., subsidies to water withdrawals or lack of water-sharing arrangements) or express policy choices (decisions to maximize water use to establish water rights or grow crops domestically for food security rather than import) may be impeding more efficient water management.

The dual view juxtaposing international indicators of basins at risk and market indicators of potential supply solutions furnishes a mixed picture of the crucial role of governing institutions, suggesting that they can act both as shock absorbers against water conflicts and sticks in the spokes of water policy improvements. Workshop participants sought to elucidate the relations between water policy institutions and environmental pressures, asking under what conditions and in what forms institutions are robust to environmental changes; when water stresses (possibly combined with other burdens) could overwhelm governance capacities; and when poor governance could aggravate environmental stress.

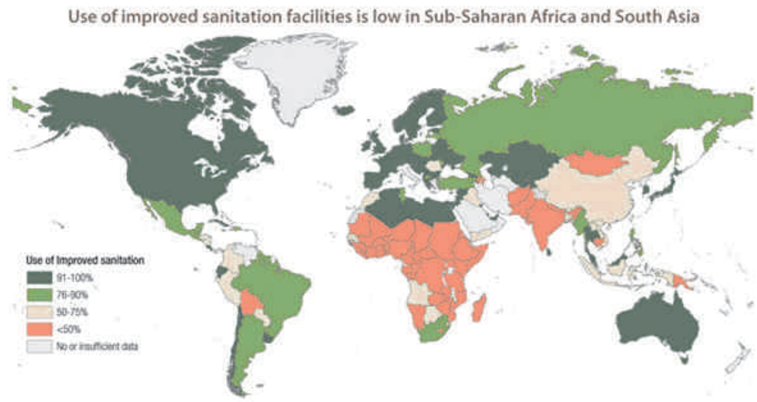


2030 Water Resources Group, "Charting Our Water Future: Economic frameworks to inform decision-making", McKinsey & Company 2009, p.77. (U)

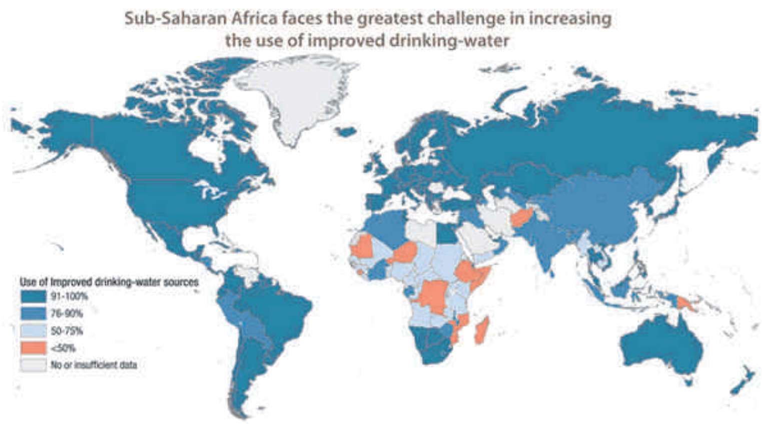
Participants also opened new avenues of approach for exploring the links between water supplies and human security. Some experts noted that water scarcity may provide an indirect spur to social instability if it pushes water-stressed rural populations from struggling farms toward the cities. Other experts wondered about the social ramifications of water policies that reduce agricultural demand for water—by increasing imports, switching crop varieties, etc.—but that concomitantly reduce agricultural demand for labor, similarly pushing rural populations toward the cities. Indeed, violent water clashes, such as the strikes and riots that frequently accompany the privatization of water services, increasingly stem not from scarcity *per se* but from policies intended to address scarcity. Policymakers think of water stress not only as a source of potential international conflict, as one policy expert remarked, but in terms of a range of outcomes and actions, including civil disorders or changes in policy behavior between actors—as for example between a suddenly vulnerable downstream riparian and an upstream neighbor building a dam. Ultimately, the participants agreed, ensuring water security must be placed in its human security context, and concerns about potential water scarcity conflicts flaring in the decades ahead must not overshadow the requirement to address the pressing needs of deprived populations living without adequate water supplies and sanitation today.

Asymmetry in Provision of Clean Water & Sanitation:
A Millennium Development Imperative & Destabilizing Force

2.6 Billion People Do Not Use Improved Sanitation



884 Million People Do Not Use Improved Sources of Drinking-Water



- 1.4 million child deaths per year from diarrheal disease
- Investment in drinking water and sanitation amounts to a total payback of $US 84 billion a year
- Political not technical failure…no esoteric technology needed (U)

Source: Figures and statistics drawn from Annette Prüs-Üstün et al., Safer Water, Better Health: Costs , benefits and sustainability of interventions to protect and promote health (Geneva: World Health Organization, 2008), at http://whqlibdoc.who.int/publications/2008/9789241596435_eng.pdf. (U)

ANNEX: Institutions:

Over the past 20 years, the ideas guiding water management have moved from conceiving water as a freely available public good towards more nuanced management techniques. Integrated Water Resource Management (IWRM) adopts a multisectoral, multiscale approach that is highly participatory in outlook and highly knowledge intensive in practice. IWRM has become the predominant policy paradigm, but as policymakers have struggled to implement comprehensive planning strategies, a number of analysts now argue that more flexible, recursively adjustable or Adaptive Water Resources Management tools are needed.

International water law has come to espouse a similarly participatory, multisectoral stance reflecting developments in IWRM. The 2004 Berlin Rules on Water Resources adopted by the International Law Association affirm that all basin states should participate in the management of any international drainage basin, whether composed of surface waters or aquifers. Less than one in five international river basins, however, is currently governed by a modern cooperative agreement. Most of these are patchwork arrangements that do not include all riparians and emphasize allocation to sovereign states rather than shared management principles. International treaties covering groundwater are even rarer, and typically incorporate groundwater only where it is related to surface waters. Very few agreements address shared groundwater specifically. Even so, transboundary basins have seen a resurgence of international agreements in recent years with an increasing focus on cooperative, adaptive processes such as dispute resolution mechanisms.

The ongoing shift in water management approaches raised several unresolved questions for workshop participants. IWRM has never adequately defined the concept of "participation". What are the proper modes for stakeholder participation? What actors need to be included in negotiating and implementing a common water policy architecture? Parallel to the trend towards IWRM, there has also been an increase in cooperative agreements around individual water projects. Could such localized arrangements establish a more effective framework for managing shared resources than broad, basin-wide processes? By the same token, as water planners seek to develop more flexible policy tools, adaptable to uncertain future environmental and socio-economic changes, how should adaptability be defined? Policies adaptive to some stresses may be ill-suited to other pressures at different scales. Policies some sectors or stakeholders find flexible may constrain others.