

## The Importance of Water Management in a Changing Global Waterscape

The Honorable Margaret Catley Carlson

When we talk, as we often do, about the importance of effective water management in a changing world, the first question we should ask is, “What is changing?” The answer to that question is, “A lot.” Beginning in 1750, human enterprise began to dramatically alter the world. Since 1950 that activity has accelerated exponentially. When we examine patterns of growth in a broad range of human-related activities, as James Gustave Speth did in his book *The Bridge at the Edge of the World: Capitalism, the Environment and Crossing from Crisis to Sustainability*, we see how the pace of change has accelerated between 1750 and the present. We see clearly the enormous influence that global population growth, urbanization, and increasing wealth have had on water use, dam development, agricultural production, fertilizer use, paper production, and automobile availability. We also see the consequences of accelerating growth in these areas on the atmospheric concentrations of carbon dioxide, nitrous oxide, and methane. Similarly, the combined effects of population increases, land-use change, and greenhouse emissions on atmospheric temperatures, the number of extreme flooding events, ocean biogeochemistry, fisheries decline, and species extinctions are also illustrative. The Earth is indeed undergoing rapid and accelerating change, and this change is reflected in the global waterscape.

Water stress is typically defined as the ratio of total freshwater withdrawals compared with the annual renewable freshwater supply. High levels of water stress are an indication that socioeconomic demand for freshwater is approaching or exceeding annual renewable supply. If we project current trends forward to 2025 we see that even with only a moderate degree of climate change many highly populated places in the world

will face seasonal or permanent water stress. It is important to note that when looking at such maps that the aggregation of stress trends in larger countries like China, India, Russia, the United States, and Canada can mask the risk of social disruption due to water stress at regional and local levels.

When we examine per capita renewable water resources on a regional basis, we see clearly that areas such as the Middle East and North Africa are going to suffer disproportionately as water stress intensifies in the coming decades. We also see that there is a nexus at which water, food, and energy are interlinked. On average it takes a liter of water to produce every calorie we eat. The pending crisis becomes apparent when we examine how much more water and energy will be required to grow cereal grains to meet the doubled global food demand that we expect by 2050. Without productivity gains, water and related energy needs will double by midcentury.

Water and energy are engaged in inextricably linked interplay. It takes a lot of water to produce energy. Water is a crucial input at all stages of the power generation cycle, not just in hydropower production but also in processes of the mining and refining of energy minerals and coal and gas liquefaction and gasification. Abundant water is also required for processing of crude oil, tar sands, oil shale, natural gas, coal, and uranium. Water is a vital input in the growing and processing of biofuels, in thermoelectric cooling, in the transportation of energy products, and in emissions controls and carbon sequestration.

It also takes a great deal of energy to produce water. Energy is required to abstract, purify, and distribute water for use and to transport it through pipes and canals. It is also required for extracting water from underground aquifers, for managing and treating wastewater for reuse, and for desalination of brackish waters and seawater to provide new water sources.

Regarding potential consequences of climate change, with each degree of projected atmospheric warming, new risks emerge or increase. We have already observed that with a global temperature rise of only 1°C, small mountain glaciers are disappearing and water supplies are being threatened in some areas. At between 2°C and 4°C we should expect significant decreases in water availability in many areas, including the Mediterranean and South Africa. Beyond 4°C, patterns of crop production shift globally, and sea level rise threatens many of the world's largest coastal cities. Rises in temperature of the same range also directly affect agriculture. The rising intensity of storms, droughts, flooding, and heat waves is

already hampering growth in agricultural productivity in many developed countries. While increased yields may be possible in some higher-latitude regions, temperature increases beyond 2°C are projected to stall if not reverse growth in agricultural productivity in many important food-producing areas. It may only be a matter of time before water scarcity and disrupted climatic patterns bring about the next food crisis. We could soon be facing annual losses equivalent to the entire grain crops of India and the United States combined.

An impressive array of activities are already underway that may be helpful in fashioning strategic responses to increasing climatic variability. Globally, some of the contemporary agricultural research focuses on development of new seeds for drought-resistant crops, water-saving crop management schemes, and devising incentives for reducing water use. Attention is also being devoted to developing crop types that can flourish in saline water. But it is not just agriculture that is concerned about growing climate variability: other industries are focusing on likely consequences of changing climate variability for their operations. The insurance industry has observed that between 1980 and 2008 the frequency of major flooding disasters and highly damaging windstorms have increased by 8% and 4% respectively, with commensurate increases in insured losses. These observations are a harbinger of even greater increases in weather-related damages in the future.

Key players in the public sector are also worried about the changing global waterscape. The United States National Intelligence Council recently released an assessment of the security implications of a growing global water crisis (Intelligence Community Assessment 2012). The bottom line of the report was that “during the next 10 years, many countries important to the United States will experience water problems—shortages, poor water quality, or floods—that will risk instability and state failure, increase regional tensions, and distract them from working with the United States on important U.S. policy objectives. Between now and 2040, freshwater availability will not keep up with demand absent more effective management of water resources. Water problems will hinder the ability of key countries to produce food and generate energy, posing a risk to global food markets and hobbling economic growth. As a result of demographic and economic development pressures, North Africa, the Middle East, and South Asia will face major challenges coping with water problems” (National Intelligence Council 2012).”

A second report published by the National Research Council in the United State entitled *Climate and Social Stress: Implications for Security Analysis* arrived at the same conclusions. The report notes that: “Changes in the availability of water resources may play an increasing role in political tensions, especially if existing water management institutions do not evolve to take better account of the social, economic, and ecological complexities in the region. Agreements will likely reflect existing political relations more than optimal management strategies. The most dangerous situation to monitor for is a combination of state fragility (encompassing, e.g., recent violent conflict, obstacles to economic development, and weak management institutions) and high water stress” (National Research Council 2012).” The lack of effective management strategies for the changing global waterscape may become a global security threat.

It is no secret that water is badly managed—or simply not managed at all—in many places. Most water problems are problems of governance. For most governments, management of water is a difficult political problem. It is a matter that is expensive to address and fraught with emotional, no-win issues. Governments have tended to play safe with water issues, relying on traditional infrastructure and capital projects that can be perceived publicly as high-visibility solutions. Most governments, however, are far better at creating and announcing policies than they are at implementing them.

The question becomes, How do we deal with this? How do we govern in a far more water-, food- and energy-stressed world? What does the extraordinary pressure we are putting on the water-energy-food nexus do to power relations? What trumps what? Do urban concerns trump rural concerns? Is energy more important than water?

A significant amount of technical and scientific research is available on changing global and regional hydroclimatic conditions and their impact on the water-energy-food nexus. However, there is very little new research directed at questions of how to design and implement effective governmental institutions that can address issue of water, energy, and food, as well as the interactions among them.

The prospects for change in this situation are not good. International cooperation appears to be declining in this new century. The Rio+20 outcomes, for example, were characterized by some observers as “the longest suicide note in global history.” What appears to be happening globally is that we are going backward toward fragmentation.

Three big changes in particular are making governance more difficult. These include the explosion of global water demand; new and emerging contamination threats; and rapidly accelerating urbanism. In addressing these concerns it is important to note that the large-scale conference diplomacy through which solutions to such matters were typically negotiated in the twentieth century no longer works. New forms of negotiated cooperation over the management of water, such as the European Water Framework Directive, are emerging, but they remain at odds with multicentered, multispectral, decentralized forms of government—coalitions of the willing that typify the global fragmentation of governing institutions.

There appears to be a huge gap between awareness of these problems and the amount of policy attention they receive. Each year the World Economic Forum evaluates the threats posed by fifty global economic, environmental, geopolitical, societal and technological risks of concern in the immediate and long term. In 2012, the World Economic Forum ranked water-related issues fifth in terms of their likelihood of slowing economic performance globally. In 2013, the global water supply crisis was ranked fourth among threats generally but second in terms of its potential to impact the performance and survival of businesses in many sectors of the global economy. Despite this, governments around the world give these threats little or no policy attention or, as in the case of countries like Canada, ignore the threat completely while gutting legislation created by earlier governments that does attempt to protect the basic resource.

Most countries do not have policies that treat water, food, and energy in an integrated, interrelated fashion. Such policies will be essential in the future, however. Increasingly, energy production competes with agriculture for water. New energy-producing technologies such as hydrological fracturing, or “fracking,” will change the water using characteristics of the energy sector. These changes will have significant consequences for the interrelationships of energy with water and energy with food.

Increasing competition for scarce water resources has become a growing business threat and a major economic issue that cannot be ignored. The private sector, therefore, is now being forced to strengthen the hand of government to act on these issues in order to prevent water-related issues from becoming serious threats in their sectors. Strengthening the hand of the government with respect to water policy is also seen as vital to the competitive advantage in business and in some cases vital to sector survival.

The global water supply crisis in tandem with food and energy security issues is creating new players and new managerial roles in water governance. This appears to be leading to increased attention to the development and implementation of effective water policy. Such policies must call, in the first instance, for effective water resource monitoring and data management, a fundamental prerequisite for effective management. Development of workable regulatory frameworks, risk management, water and energy conservation, and synergy and training and investment require increased attention if current and prospective water management problems are to be addressed successfully.

Water quality is also becoming more critical because degradation of water quality limits available supplies just as surely as does drought. The need to monitor water quality parameters significantly increases the magnitude of needed monitoring and data management. Big data requirements are also leading to big changes. Once the exclusive responsibility of national governments, processes of data collection, assembly, and access are today being privatized. Highly transparent, decentralized, multilayered information depositories help both business and government but also enable civil society to know about and act upon water issues on a local, regional, and national basis. Satellite data are becoming crucial to the emergence of financial transparency with respect to water management. Smart meters translate integrated water and energy consumption data into information governments need to set new standards in water and energy efficiency. Organizations like the International Water Association are demonstrating how a minimal improvement of 20% in the energy efficiency of municipal water and wastewater systems compared to 1990 can be achieved by 2020. Efforts are being applied to reduce the costs of desalination continue. Large-scale food processing plants that recycle virtually all of their water are beginning to appear in places like Canada. Additionally, new technologies now allow energy to be produced from wastewater through codigestion of biodegradable wastes. These advancements and technologies make a big difference at the water, energy, food interface. More will be needed, however.

It is in cities that the changing global waterscape needs the greatest attention. By 2025, global municipal water demand will increase by 40%. The condition of urban water infrastructure globally has been in decline for some time. It has been estimated that the water-related infrastructure

deficit between 2005 and 2030 could be as much as US \$22.6 trillion. Effective action by new players, including corporatized utilities, financial houses, public-private partnerships, and other governance innovations, will be required to remove these deficits from the public balance sheet. But fixing urban infrastructure will not be enough. A new urban hydrosocial water contract needs to be negotiated globally. That contract needs to link water security to public health protection; flood protection; social amenity and environmental protection; sustainable management of limited natural resources; and intergenerational equity and resilience to climate change.

The global waterscape has changed dramatically in the past 250 years. More places are becoming water stressed, and more will become so in the coming decades. Water governance is becoming far more difficult. Many governments lack the capacity to take on the kinds of difficult reforms that are required. New technologies, new management tools, and growing public and private sector pressure provide ever-stronger demands and support for public efforts to improve water policies. For the purposes of this forum, three lessons emerge from an examination of where we have been and a look forward to the water management imperatives of the future.

- First, growing water stress is a serious global social, economic and environmental threat. Addressing that threat will require building bridges between scientists and politicians. Without such bridges, crisis and conflict are a real possibility in places of increasing water stress like the Middle East and North Africa.
- Second, the action in terms of scientific, policy, and political change should be focused on the water-energy-food triangle and its various interrelationships.
- Third, strengthening the government hand with respect to water policy is increasingly seen as vital to competitive advantage in business and in some cases to sector survival. It is also vital in promoting intergenerational equity and the social and environmental resilience that will be required to sustain us as the global waterscape redefines itself around emerging new hydroclimatic realities.

## References

- Intelligence Community Assessment. 2012. Global Water Security. ICA 2012-08, 2 February 2012.
- National Research Council. 2013. *Climate and Social Stress: Implications for Security Analysis*. J. D. Steinbruner, P. C. Stern, and J. L. Husbands, eds. Washington, DC: National Academy Press.
- Office of the Director of National Intelligence. 2012. *Global Water Security: Intelligence Community Assessment ICA-2012-08*. <http://www.fas.org/irp/nic/water.pdf>.
- Speth, J. G. 2008. *The Bridge at the Edge of the World: Capitalism and the Environment and Crossing from Crisis to Sustainability*. New Haven: Yale University Press.