Water Insecurity and Water Scarcity

Introduction

This paper will discuss two major issues in the discourse about global water freshwater supply: first, the broad-based scarcity of freshwater on the national and global scale; and second, water insecurity among individuals, especially in developing countries.

There are many reasons to worry about the future of global water supply. Research by the World Economic Forum Water Initiative indicates that the world's population will likely grow to 8 billion by 2026, that developing countries will command global economic growth, and that an ever-increasing number of individuals will migrate to cities (2011, pg. 7). These trends will clearly lead to an increased demand for freshwater to sustain population growth, especially in the booming cities of developing countries around the world.

These numbers might not be so problematic if demand for water grew at the same rate as population growth; however, historical trends indicate otherwise. In the ten years between 1990 and 2000, "the world's population grew by a factor of four, but freshwater withdrawals grew by a factor of nine" (World Economic Forum Water Initiative, 2011, pg. 9). There is reason to believe that, as economic growth improves the standard of living in developing countries, individuals in these countries will demand larger quantities of freshwater. The World Economic Forum Water Initiative predicts adverse consequences in the short term, including a "40% shortfall between water demand and available freshwater supply by 2030" (2011, pg. 9). Domestic demand is expected to increase by 75% between 1995 and 2025, with most of the change occurring in developing countries (World Economic Forum Water Initiative, 2011, pg. 115).

Though analysis suggests that domestic and household demand in water and energy will rapidly increase, the majority of energy consumption will be commanded by budding industries in developing countries. By the year 2030, industry is expected to command most of the 40% predicted increase in energy demand worldwide (World Economic Forum Water Initiative, 2011, p. 111). At present, agriculture demands a full 70% of the world's freshwater withdrawals (World Economic Forum Water Initiative, 2011, p. 10). Considering the exploding individual demand for foodstuffs and freshwater in developing cities, "unless there is a radical improvement in how agricultural water is managed and used, there will simply not be enough water to grow the food needed to adequately meet the demands of an increased population and changing diets by 2030" (World Economic Forum Water Initiative, 2011, p. 25). Governments in developing countries will be forced to make the choice between allocating water to food production for their citizens or to industrial growth (World Economic Forum Water Initiative, 2011, p. 74).

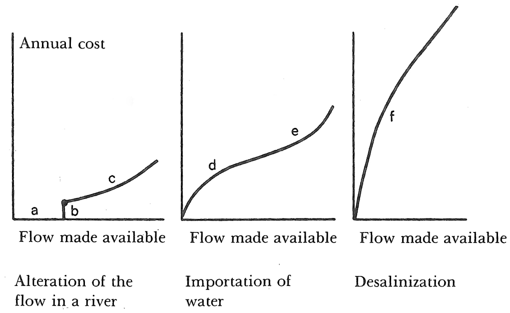
Reasons to Fear: Changing Tastes, Growing Energy Demand, Water Purification and Transport, and Global Water Stress

As has been mentioned, global economic growth will likely generate added demand for foodstuffs and larger quantities of food waste, even as much of the world's population continues to languish in starvation and poverty. Josette Sheeran, the former Executive Director of the World Food Programme, stated in 2008 that demand for meat will increase by 50% between 2008 and 2025, that fully one-third of food in richer countries is wasted, and yet one-sixth of the global population does not receive adequate nutrition (World Economic Forum Water Initiative, 2011, p. 19). While demand for meat and animal products is part of a high-quality diet, meat and animal products require massive quantities of water to produce. Calorie for calorie, plants require only one-tenth of the water necessary to produce meat (World Economic Forum Water Initiative, 2011, p. 20). Seemingly minor differences in diet create massive effects in water footprint: "the average daily diet in California requires some six thousand liters of water in agriculture, compared to three thousand liters in countries such as Tunisia and Egypt" (World Economic Forum Water Initiative, 2011, p. 20). This disparity in human consumption, and its corresponding water demand, is important, because some 40% to 90% of water used in agriculture to grow food is evapotranspired and cannot immediately be reused as freshwater (Rijsberman, 2005, p. 10). Contrast this to domestic water use, in which approximately 90% of freshwater is returned as recyclable wastewater (2005, p. 10).

A second major reason to fear is growing energy use and the massive hidden water requirements that accompany each energy source. It is necessary to use water both to recover and refine energy. Some water-intensive energy sources include hydraulic fracturing and other enhanced recovery techniques, requiring 50 - 9,000 liters of water per GJ to recover; the mining of oil sands (70 - 1,800 liters per GJ); petroleum refining (25 - 65 liters per GJ); biofuels, including corn and soy (9,000 - 270,000 liters per GJ); and coal mining and processing (145 - 290 liters per GJ) (World Economic Forum Water Initiative, 2011, p. 45-49). Energy production demands some 8% of global freshwater withdrawals, though it should be noted that much of this water is used for cooling and then returned to the water body (World Economic Forum Water Initiative, 2011, p. 44). Moreover, energy production will likely grow at rates equal to or faster than population growth, creating demands for water aside from those traditionally counted among an individual's domestic demand.

A third major reason to fear is the cost of water purification and transport. In terms of human consumption, quantity is not all that matters: water resources must also meet a high quality standard in order to be considered sufficient. Developed countries exemplify benefits of quality water supplies, as advanced water infrastructure has enabled developed nations to "[alleviate] human suffering and [improve] the quality of urban life" (World Economic Forum Water Initiative, 2011, p. 112). However, pure water does not come without effort, and criteria for water quality require it to "contain no organisms which cause disease;" "be sparkling clear and colorless;" "good tasting, free from odors, and preferably cool;" "reasonably soft;" "free from objectionable gas...and objectionable minerals;" and be "plentiful and low in cost" (Hoover, 1970, p. 1). These criteria are generally guaranteed in developed nations, but they are far from guaranteed in developing nations.

Figure 1: The Costs of Water Provision and Transport (Falkenmark & Lindh, 1976, p. 143).



Three examples of the cost of making water available.

An additional aspect of water provision regards its transport. The following graphic from Swedish hydrologist Malin Falkenmark, the creator of the water stress index which will be discussed later in this paper, outlines three different alternatives for water transport and purification, including altering a river's flow, importing water, and desalinization. In the case of altering river flow, region a represents the amount of water which can be taken from the river without constructing any infrastructure, region b represents the cost of building a dam, and region c depicts the ongoing cost of maintenance for this dam. The middle diagram, showing the importation of water, depicts regions d and e with their associated costs and returns to scale. Finally, the desalinization diagram depicts curve f, representing the massive investment required to desalinize water and maintain desalinization systems. In the face of rising global demand, the cheapest and most overused resource will be surface water in lakes and rivers, and the cost of adapting water provision systems to global water scarcity will be significant.

The final reason to fear global water scarcity involves water stress by country. The most common indicator of water scarcity is the Falkenmark indicator, also called the "water stress index." The Falkenmark indicator establishes simple numerical criteria: Countries require 1,700 cubic meters of water per capita per year to provide for an individual's water requirements in all sectors (Rijsberman, 2005, p. 6). Supplies below 1,000 cubic meters and 500 cubic meters of water per capita per year are considered water scarcity and absolute scarcity, respectively (Rijsberman, 2005, p. 6). Under the guidelines of the Falkenmark indicator, researchers estimate that about 700 million people across 43 countries live below the cutoff level of water scarcity (Mukheibir, 2010, p. 1029). It should be noted that while the Falkenmark indicator is easy to grasp, it receives criticism for disregarding variations in demand, differences in infrastructure, and differences in provision among individuals at the micro level (Rijsberman, 2005, p. 8). The Falkenmark indicator nevertheless highlights important differences in freshwater provision between countries.

Reasons to Hope: Water's Constant Presence in Biogeochemical Cycles

Amid the rightfully alarmist rhetoric surrounding global water scarcity, it must be acknowledged that water never "disappears" from the earth. Water may be stored in different places at different times — in the atmosphere, drainage water, rivers, and even manufactured products — but the truth remains that "[e]xactly the same water is circulating today as in the days of Cleopatra" (Falkenmark & Lindh, 1976, p. 14). In order to meet rising human demand, two primary challenges exist: first, to ensure that an adequate amount of freshwater is preserved to meet human demand at any given time; and second, to ensure that the individuals who need water most receive this water through delivery and financial services.

Water Insecurity and Water Scarcity

It can be tempting to confuse water insecurity in individual experience with water scarcity in the global sense. One must resist conflating these two phenomena. At the present moment, water insecurity, especially across developing regions, is not necessarily caused by worldwide water scarcity. Rijsberman establishes a clear division between water insecurity and water scarcity, saying, "When an individual does not have access to safe and affordable water to satisfy his or her needs for drinking, washing or their livelihoods we call that person water insecure. When a large number of people in an area are water insecure for a significant period of time, then we can call that area water scarce" (2005, 6). Though certain geographic regions suffer from water scarcity and rapid depletion of natural resources, many of the problems of physical availability of water can be attributed to political and institutional faults (Mukheibir, 2010, p. 1029). This section of the paper will compare water provision in developed and developing nations — of which many nations, regardless of their economic development, are arid — to show that the problems of water insecurity are largely political and institutional problems.

Take first the high-income developed nations. In these countries, regardless of their aridity, all urban households expect drinkable water delivered to their homes 24 hours a day, internal plumbing, and private toilets in every residence (UN-HABITAT, 2003, p. 2). Access to water is unquestioned, though the purity, convenience, and cost of water remain important factors (World Economic Forum Water Initiative, 2011, p. 2).

In contrast, the criteria for "improved" provision of water in developing countries are mediocre at best. "Improved" provision means "'reasonable access' to a water supply from a household connection, a public standpipe, a borehole, a protected dug well, or a protected spring and rainwater connection," provided that at least 20 liters of water is available per capita per day within one kilometer of an individual's dwelling (UN-HABITAT, 2003, p. 5). The supply of this water could easily be intermittent and serve 5,000 other individuals, and it would still fall under the definition of "improved" as long as it were located near an individual's dwelling and provided lots of water some of the time (UN, 2003, xviii). The difficulty that individuals face in attaining water reflect in the so-called "non-revenue losses" of urban water supply in Delhi, Dhaka, and Mexico City, where two of every five gallons leak from the pipes and are sold illegally (World Economic Forum Water Initiative, 2011, p. 113). Many poorer countries lack the infrastructure that individuals in developed nations take for granted.

Development and Conservation Approaches

There have been two major approaches to providing water for the cities and individuals that need it most. The first, and most commonly known, approach to providing water for all falls under the paradigm of "sustainable development." Sustainable development "usually focuses on local resources and impacts in relation to the provision of basic services and livelihoods" (Mukheibir, 2010, p. 1031). The sustainable development approach was ensconced in the Millennium Development Goals, as well as in the later Sustainable Development Goals. While sustainable development is lauded for its practicality and emphasis on local resources and experiences, this approach tends not to incorporate input from the scientific community in terms of climate change. Oftentimes, sustainable development projects have neither the budget nor the political support to plan for the long term.

A second, and rising, approach is "Integrated Water Resource Management" (IWRM). Unlike sustainable development, IWRM places the global scarcity of water at the center of conservation and allocation policy. Mukheibir further differentiates IWRM in that its geographic focus is broader — working at the "regional or catchment level" — and in that resource planning incorporates water scarcity in the medium term (2010, p. 1032). IWRM is thus more open to linking the information provided by the scientific community to the policies formulated by development experts. However, because IWRM casts a broader geographical net, it tends to ignore the water insecurity faced by many individuals.

Development experts and city planners risk either conflating the definitions of water scarcity and water insecurity or ignoring the constraints of water scarcity altogether. Research from the American Geophysical Union laments the lack of dialogue between the development and the scientific communities: "There is an abundance of evidence to support the notion that much of the science produced for climate impact assessment has not been incorporated into long-term water planning or climate adaptation efforts" (Wheater & Gober, 2015, p. 5411). Though there has been an abundance of research on climate change and water scarcity, this information has "[lacked] the credibility, salience, and legitimacy needed for it to resolve politically contentious and socially significant issues surrounding today's water resource management" (Wheater & Gober, 2015, p. 5411).

However, there is hope for positive change. Scientific community research on water scarcity is absolutely relevant in planning to provide individual water needs in developing communities, as well as in planning for water conservation in developed nations. One way forward is called the "soft path for water." The "soft path" was initially coined for the energy sector, but in this sense, the soft path for water emphasizes the "the improvement of the overall productivity of water rather than endlessly seeking new supplies — as the appropriate response to water scarcity" (Rijsberman, 2005, p. 19). Development approaches must emphasize conservation, long-term planning with input from the scientific community, and equitable water provision for individuals regardless of where they live.

References

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