WORLD SAVVY

MONITOR




Water Around the World

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Issue 11, November 2009

World Savvy
think beyond your borders

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Desert Earth: Tomas Castelazo

Letter from the Editor

Exploring the role of water in the world today is a difficult task. Water is obviously essential to survival, but its access, distribution, uses, and misuses present a very complex picture, and one that overlaps with many other issues confronting the global community today. As you consume international, national, and local news, notice how many stories are about water, even when water is not ostensibly their subject. From environmental sustainability to poverty to war to food to business to women to children – these are all, in some way, stories about water. In the classroom, these stories are great ways to teach about Science, Math, English, History, and more. A tangible issue like water can also serve as an excellent illustration of the many intertwining dependencies which characterize today's world.

Recognizing the importance of water in our lives, societies, economies, and nations is becoming more urgent, as stresses to the system become more prevalent. Benjamin Franklin wrote in Poor Richard's Almanac in 1746, "when the well is dry, we know the value of water." We invite you to explore the challenges and opportunities faced by the global community in stewarding this vital resource.

Sincerely,

The World Savvy Monitor Team

The *World Savvy Monitor* is a service of World Savvy, an education non-profit with offices in San Francisco, New York, and Minneapolis-St. Paul. All donations to the Monitor support World Savvy's work in the public schools. See worldsavvy.org.

The November edition of the *World Savvy Monitor* was written by Cate Biggs. The *Monitor* is edited by Anita Trachte and Laura Neumeister. The Classroom Companion is written by Kelly Korenak and Linda Chang. Charmagne Campbell-Patton manages production and outreach. Jenny Singleton provides production and technical support. Steff Eiter is our webmaster. Edward Wang leads foundation and individual donations. Dana Curran Mortenson, Casey Budesilich and the World Savvy Board provide program oversight.

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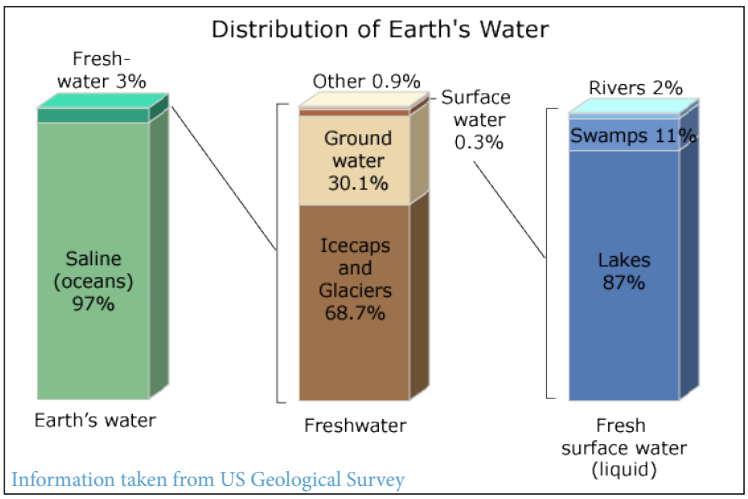

Did You Know?

- The water cycle is a closed system. All of the water on earth today existed when the planet was first formed. Within this cycle, water is constantly changing forms. At any given time, only *2.5% is freshwater*.
- Without food, a person can live for weeks. Without water, a person can only live three days.
- The recommended daily water requirement (for drinking, washing, cooking and sanitation) is about *13 gallons per person per day*. Americans use up to 150 gallons per day; people in developing countries have trouble finding five gallons.
- Demand for water has increased exponentially with population growth. Over the past century the world's population has quadrupled, and water use has increased nine-fold. There are currently 6.8 billion people on the planet; by 2050, there will be over 9 billion.
- Currently, 1.1 billion people lack reliable and consistent access to safe water for basic household consumption, and 2.6 billion lack water for adequate sanitation.
- Disease resulting from the lack of clean water and sanitation claims *over 3 million lives every year*; nearly 2 million of these are children, roughly one every 15 seconds. Ninety-eight percent of these deaths occur in the developing world; 80% would be preventable if access to clean water were secured.
- Women and girls in developing countries spend an average of six hours per day collecting and carrying water. They usually collect the water by foot, sometimes for a distance of miles. Water weighs eight pounds per gallon.
- Water is a $400 billion global industry, the third largest behind electricity and oil. Fifteen percent of the people in the world who have access to water get it through private companies.
- *Agriculture* takes the lion's share of the world's fresh water – 70% globally and up to 90% in some countries. *Industry* is the next thirstiest sector, including the water that is required to produce energy of all kinds.
- Two hundred and sixty-three river basins and countless aquifers cross the political boundaries of two or more countries. These trans-boundary water systems cover half the world's surface and cross the territories of 145 countries.

The sole water supply in Wilder, Tennessee in 1942.

Courtesy Wiki user Vmenkov.

A popular spring at Yeli Island, Zhudai, China.
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Understanding the Headlines

What is meant by the term "water stress?"

- The world has the same amount of water it has always had. The water cycle is closed, meaning that water can neither be created nor lost. Water is constantly changing forms within this cycle, and at any given time relatively little water is in a form usable by humans.
- Water stress means that *we don't have enough water where we need it, in the form in which we need it, when we need it.*
- Some water stress is physical, as in areas where water is naturally in short supply. Other water stress is economic, characterized by lack of access to existing supplies.

Why is there water stress in the world today?

- The primary reason for water stress is the great *population growth* over the past century. More people means more demand for water. Feeding all these people takes a lot of water – not only because of the sheer number of mouths, but also because of what people are eating and how their food is being grown and processed.
- *Economic development* over the past century has also vastly increased the demand for water. Industry uses an enormous amount of water to provide the goods and services associated with modern lifestyles. Among the thirstiest of industrial sectors is energy production, including hydroelectricity, coal, oil, and nuclear energy.
- How humans have responded to increased water demands has also contributed to water stress. *Competition for freshwater* means that water is increasingly being diverted by dams and obtained in unsustainable ways that disrupt the water cycle. *Climate change* is altering weather patterns, causing freshwater to move more slowly or more quickly through its various forms, and altering where and when humans can access it. This is happening in ways we do not fully understand, and will likely have effects on water that we cannot yet predict.

How are the world's freshwater resources distributed?

- *Unevenly*: Fully half of freshwater is located in just six countries. Some densely populated countries are extremely dry.
- *Across political boundaries*: Ninety percent of the world's population derives its water from river systems that cross domestic or international borders. Managing these supplies is challenging on many levels.
- *Unpredictably*: Places where plentiful water supplies used to exist now experience drought; other areas now have too much water in the form of floods. Extreme weather events produce high volatility where there was once manageable variability. This is thought to be related to climate change. The effects of this volatility have been compounded by human activity that interferes with water absorption and water flows.

What happens when water supplies and demand are out of sync?

- *People die*: Over 3 million people die each year from water-related diseases. Hundreds of millions more are sickened or suffer physically from inadequate and/or contaminated water, most in developing countries.
- *Livelihoods are lost*: From destructive droughts to floods to water that is simply out of reach logistically and financially, the economic costs associated with too much or too little water range from loss of household income at the individual level, to significantly curtailed GDP at the national level.
- *Potential is wasted*: Girls and women in the developing world spend valuable time collecting water, time that is not spent going to school or working for wages. Health care costs associated with preventable water-related illnesses cost the global community billions each year.
- *Global inequalities become more entrenched*: Water stress is both a cause and a result of poverty. Poor countries have difficulty accessing and managing water supplies for a variety of reasons, which in turn curtails economic development.

Is water a public good, a commodity, or a human right?

- Water is a public good, a commodity and a human right; these multiple identities often conflict.
- *As a public good*, theoretically water should be held by the public for the benefit of all. But, as with all public goods, a "tragedy of the commons" often results in which unrestricted individual use degrades the resource. The public sector is not always equipped to manage water; from up-front investments to maintenance of infrastructure to distribution, multiple levels of competent governance are required for effective water management.
- Many believe that water should be treated *as a commodity* and, as such, be managed by market forces, in which pricing drives investment, distribution, and consumption decisions. This may have the beneficial result of reducing consumption, but the resulting inequities would deprive the poor of equal access to water.
- Others believe because water is necessary for human survival, dignity, and potential, it should be treated *as a human right*. A human rights-based approach takes into consideration international norms and standards of social justice and equity. Water in this context is a basic entitlement of all people.

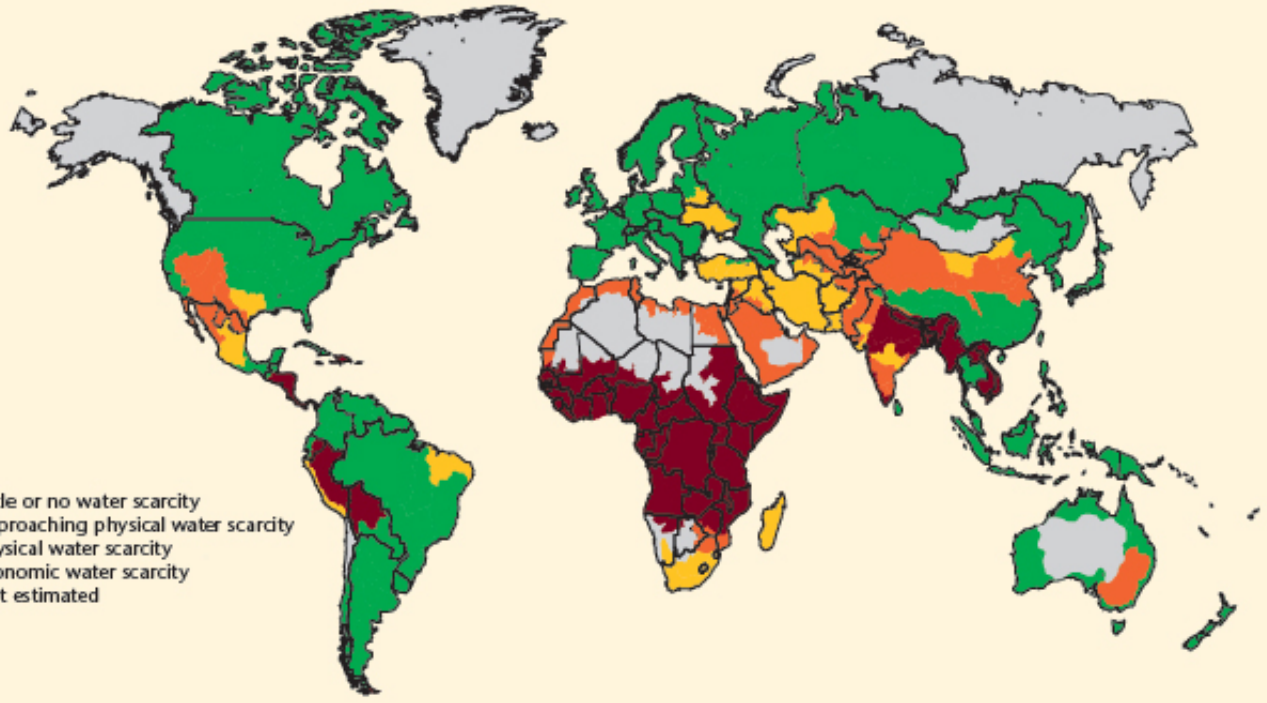
What will the best "solutions" to water stress do?

- The best solutions to relieving water stress should:
  - Moderate demand while increasing access;
  - Rationalize both personal and systemic responses;
  - Balance efficiency with equity;
  - Balance short-term and long-term needs;
  - Use technology in ways that enhance the sustainable use of water, not simply make it easier to extract;
  - Account for the needs of all stakeholders, including those who cannot pay, and treat the environment as a consumer in its own right;
  - Invest equitably and creatively, sharing responsibility between the public and private sectors, and among local, national, and international bodies;
  - Collect and use data effectively and transparently;
  - Recognize that sometimes solutions create new problems;
  - Integrate currently fragmented responses; and
  - Look not only to the water industry for solutions, but also include energy, education, conflict prevention, food security, and other experts who don't immediately come to mind when thinking about this issue.

Maps

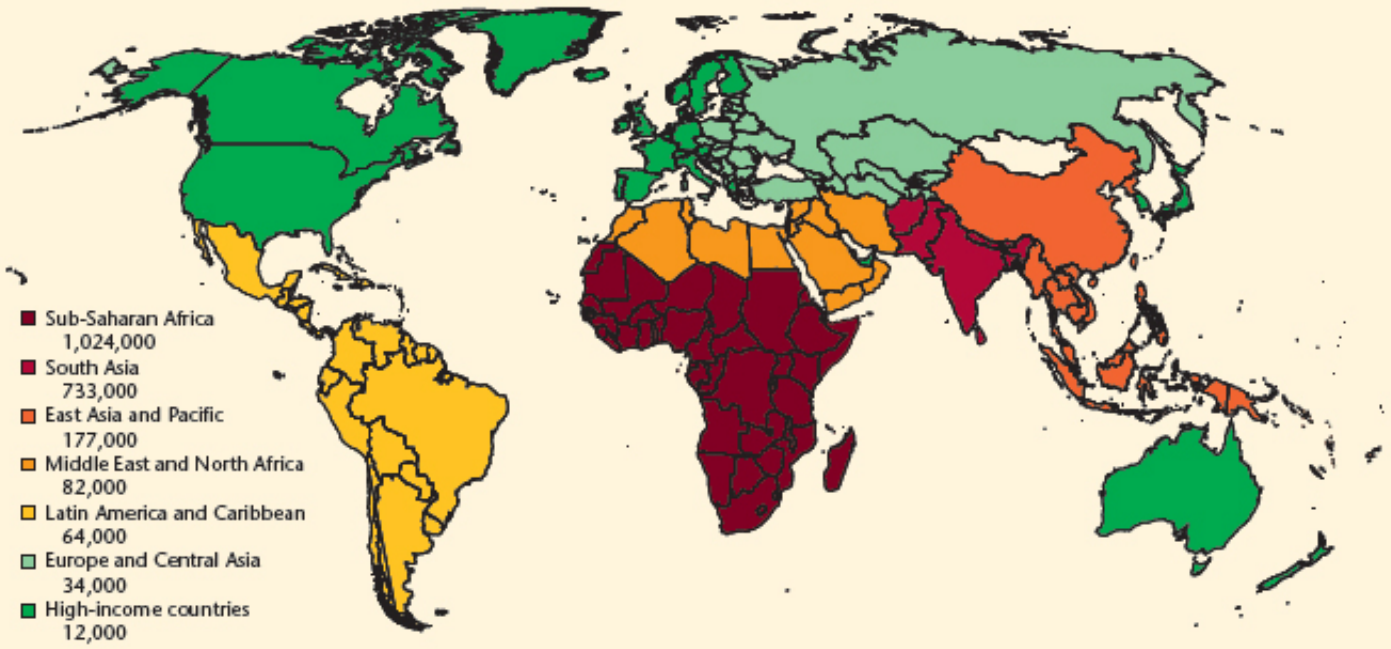
All maps in this section courtesy UN Water (http://www.unwater.org)

Map 8.1 **Increasing water scarcity**



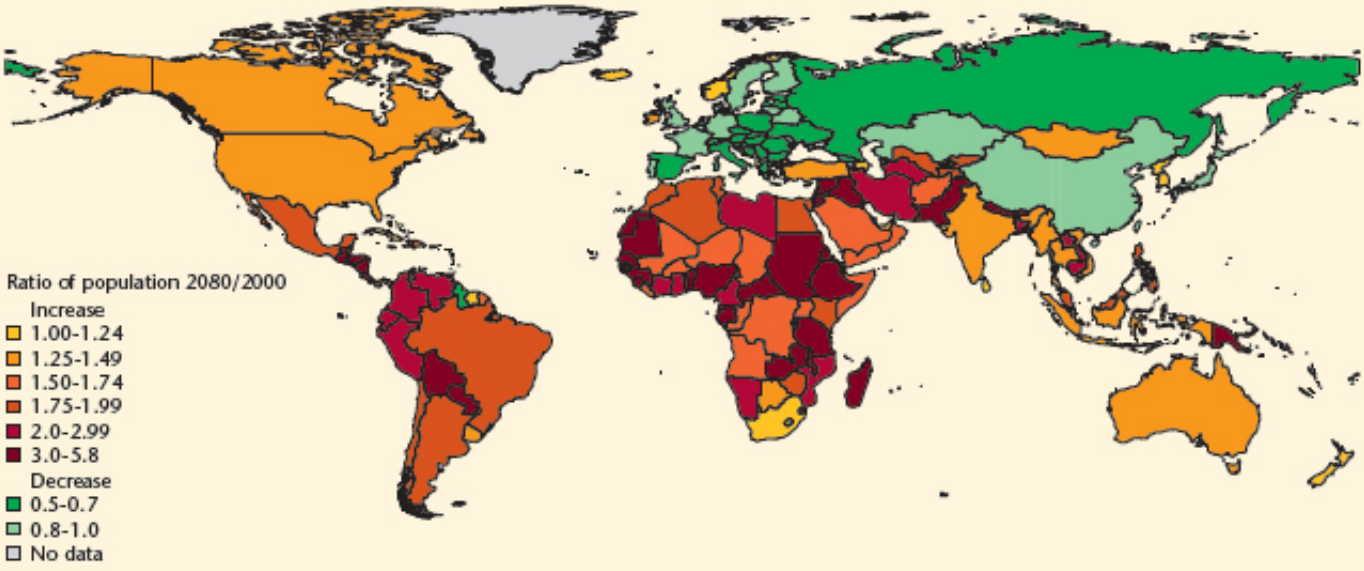
Source: Based on Comprehensive Assessment of Water Management in Agriculture 2007.

Map 6.1 **Diarrhoea deaths in 2004**



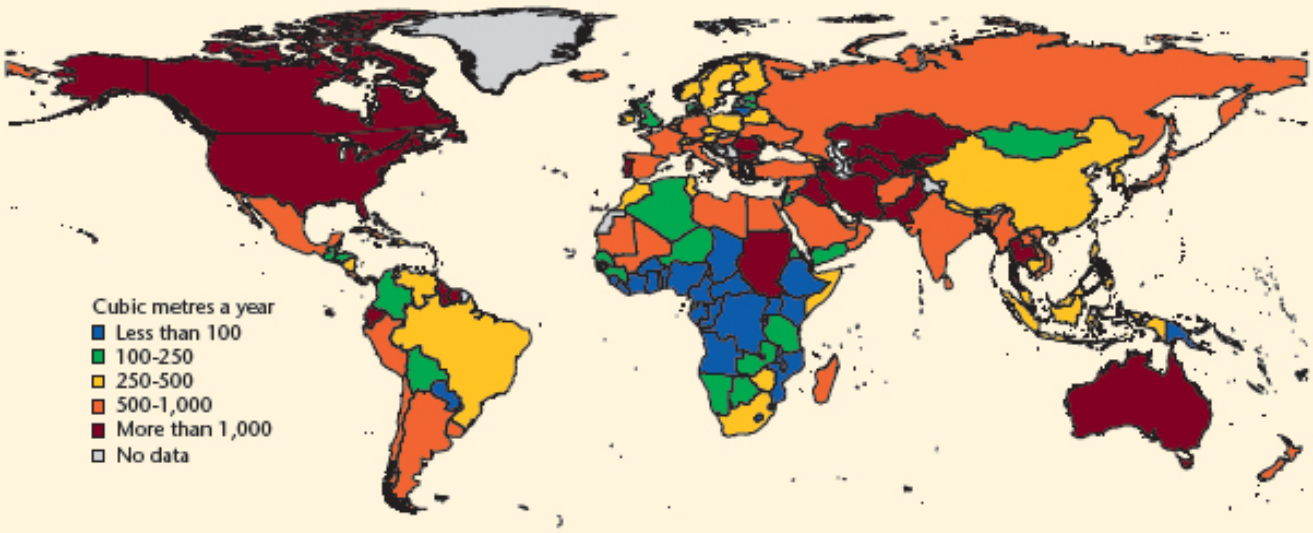
Source: WHO 2008.

Map 2.1 **Expected areas of population growth and decline, 2000-2080**



Source: Lutz, Sanderson, and Scherbov 2008.

Map 7.2 Annual water withdrawals per person by country, world view, 2000



Source: Based on FAO-AQUASTAT global maps (www.fao.org/nr/water/aquastat/globalmaps/index.stm).

Map 7.7 Important waterways in the world, 2007

Source: Based on BVB 2008.

Courtesy Wiki user Shizhao

A manual water pump in China.
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Water: A Framework for Understanding the Challenge

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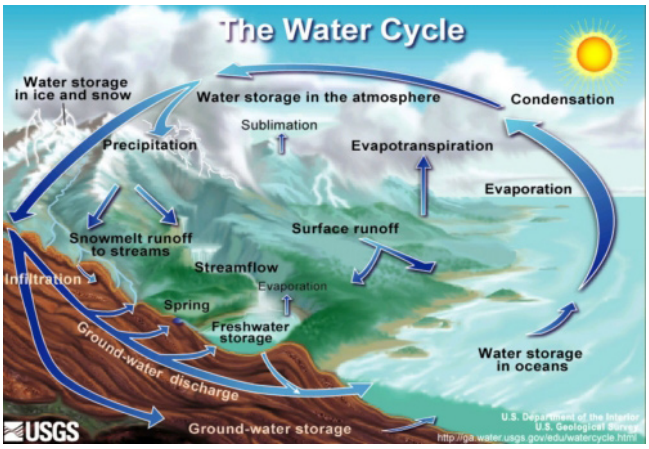

Water: A Framework for Understanding the Challenge

Overview

Water is essential for human life – not only for the systems of the body, but also for the physical, social, economic, and political systems that sustain communities and countries. Unlike some other contributors to human existence, water has no substitute or alternative.

There is general consensus in the global community today that we are facing increasing water scarcity, deriving from both population growth and mistreatment of resources.

- The demand for water has increased with population growth to the point that delivering sufficient water to the world's people has become a global challenge.
- In order to increase their access to water, humans often interfere with the water cycle itself.
- These manipulations, along with distribution challenges, mean that *the world's population increasingly does not have the quality of water where it needs it, in the form or quality in which it needs it, when it needs it.*

Water shortages or *water stress* is exasperated by *physical factors*, such as arid climates where water is scarce, and *economic factors*, which affect those places where water sources exist, but the technology and resources to extract and manage the water do not.

The World Economic Forum has said of the current worldwide water situation: "We are living in a water bubble, as unsustainable and fragile as that which precipitated the collapse in global financial markets. We use water unsustainably…we have overleveraged our water for the future; we have no means of paying this back. The bubble is bursting in some places with more to follow."

The World's Water Supply

Three hundred twenty-six million trillion gallons – that is the total estimated amount of water on earth, taking into account water in various forms as it moves along the hydrological cycle. This number represents the most water the earth has ever had and as much as it will ever have.

The Water Cycle

At any given time…

- *Ninety-seven percent of the world's water is seawater* in oceans; the remaining 3% is water vapor in the air and freshwater on land.
- Of this freshwater, two-thirds is locked up in ice caps and glaciers. One-third is in liquid form either underground (in aquifers and rocks) or above-ground in lakes, soil, wetlands, rivers, and living organisms.
- This means that only *1% of the earth's water is in a form usable by humans*. Only .4% is easily accessible in the form of lakes and rivers.

Water moves through a *hydrological cycle*, constantly changing between liquid, gas, and solid forms:

- Water in the oceans is heated by the sun and *evaporates* into the air where it is cooled. It then condenses into *precipitation* in the form of snow or rain.
- Some precipitation that falls on land ends up as *surface water* stored in lakes, rivers, and streams, either directly or through run-off. Other precipitation is absorbed and stored at various depths under the ground as *subsurface water*. Both are considered freshwater. It is at this stage of the cycle that water is extracted by humans for a variety of uses.
- Water that falls as precipitation may be put into long-term storage in the form of *glaciers, ice caps, and general snowpack*. When these melt, they recharge freshwater stores. Freshwater may also be stored deep in the ground in *rocks or aquifers* where it is slowly released naturally or accessed with greater difficulty by humans.
- Ultimately, the water that falls on land either finds its way back to the ocean through a network of above ground and underground channels, or it returns to the air as it evaporates from lakes and rivers or through plant transpiration.
- The cycle repeats.

Human Impacts on the Water Cycle

Some water moves through the cycle relatively quickly; some water enters deep storage as ice or snow or seeps deep into the ground where it remains for tens of thousands of years.

Human activity impacts the movement of water through the cycle in numerous ways. Some examples include:

- Carbon dioxide emissions that alter air and ocean temperatures, affecting currents, evaporation rates, and weather patterns. Global warming of surface water intensifies the effect of contaminants.
- Dams that alter the flow of waterways.
- Concrete roads and buildings that impede water absorption and underground flows.

An irrigated field of blueberries. Courtesy Wiki user Pollinator

- Wells and boreholes that deplete wells at rates higher than they can naturally be recharged, and that tap into ancient aquifers that can never be recharged by precipitation.
- Destruction of plant ecosystems responsible for the health of the water cycle.
- Pollution that impacts water flows and usability.

Freshwater

When we talk about water, we are really talking about freshwater. *Freshwater* is the stuff of life for earth's creatures (even sea life is dependent on freshwater as runoff or precipitation to balance out the salt content of water in the ocean).

Freshwater is subdivided by experts into a number of categories:

- *Blue water* moves above and below ground on its way back to the ocean. This is the primary source of water for human and animal life on earth.
- *Green water* is soil moisture that is absorbed by plants. It is consumed by humans in the form of crops containing water.
- *White water* is evaporated water in the air. It is not usable by humans.
- *Grey water* is wastewater, usually of poor quality but usable by humans.
- *Black water* is polluted water of such poor quality that it is considered unusable by humans.

Thus, included in the total figures for freshwater is water that is *unusable* by humans – either because of its form or because it has been degraded by human activity.

Freshwater supplies are unevenly distributed on the planet, with only six countries holding up to half the world's supply of renewable freshwater (blue water) – Brazil (which significantly outstrips other countries), Canada, Russia, Indonesia, China, and the United States.

Water Consumption

The challenge the world faces today is balancing the supply of usable water with the demands being placed on it by its various consumers.

Many Different Consumers

Unlike other resources, water has no equal substitute or alternative in most contexts. It is used in a myriad of ways, typically broken down into the following categories:

- Domestic use – drinking, cooking, washing, sanitation
- Agricultural use – irrigation, livestock, harvesting and processing food, fishing
- Industrial use – manufacturing, production of goods and services
- Energy production – electricity generation, cooling of power plants
- Transportation – shipping of goods by ocean, rivers, and lakes
- Culture and Leisure – swimming, boating, tourism, hotels, religious practices
- Environment – ecosystem health, maintenance of natural systems

Within and among countries, different stakeholders place different and competing demands on freshwater resources. The needs of all these stakeholders are growing.

Population Growth

As the world's population has increased, not surprisingly so has the global consumption of water. Domestic consumption has predictably increased, but so has consumption in each of the other sectors of water usage listed above. More people means higher demands for food, energy, and goods and services.

The thirstiest sector of the global community is agriculture, accounting for 70% of total freshwater usage in the world, most of that going to irrigation required to grow crops.

The Schuylkill River provides approximately 40% of the water used in Philadelphia.

Growing efficiencies in agricultural methods have increased food production, but at a cost to the water system.

- In the 20th Century, a Green Revolution in farming practices made it possible to feed the world's ever growing population.
- New crop strains, fertilizers, and irrigation techniques brought an exponential increase in agricultural output, defying predictions that population growth would mean widespread famine.
- Yet these new practices are highly water-intensive, and have come online without a complementary revolution in water extraction, storage, and distribution. It is estimated that up to half of all freshwater dedicated to irrigation ends up as waste or evaporation.
- With economic development has come higher meat consumption. Meat production – from feeding and slaughtering livestock to processing and packaging meat – requires an enormous amount of water. The World Economic Forum reports that a diet which includes meat requires double the amount of water to produce compared with a vegetarian diet of the same nutritional value. Global production of meat at mid-century is expected to be twice that of 2000.

With population growth and economic development have come *increased industrial demands for water, especially in the energy sector*. Water and energy are closely linked:

- It takes an enormous amount of water to produce energy (not only hydroelectricity, but also the water required to extract, process, and deliver energy from coal, oil, and nuclear power sources).

- Energy production, in turn, generates greenhouse gases, which impact the water cycle.

So although population growth per se makes a huge difference, so do the ways in which this growing population uses water.

- A report by the World Economic Forum points out that from 1900 to 2000, the amount of freshwater withdrawn from the cycle for human use increased nine-fold at a time when the population increased by a factor of four.

Where Population Growth is Concentrated

Currently 90% of the world's population growth is taking place in poor countries, a trend that is expected to continue through mid-century. Poor countries or Least Developed Countries (LDCs) have the most difficulty when it comes to balancing water supply and demand. *Poverty and water stress are inextricably linked.*

- LDCs usually lack the technology and investment necessary to collect, treat, and distribute water among consumers in an efficient manner. The losers are rural households, urban informal settlements, and small farmers.
- LDCs often lack the governance and regulation infrastructure to monitor and control water flows. People living in poor countries pay some of the highest prices for water anywhere in the world, contributing up to 10% of their income for water. (International standards hold that anything over 3% is unacceptable.)
- Desperation on the part of individuals in LDCs leads to unsustainable water extraction, such as over-drilling of boreholes that damage the environment and further stress the situation.
- Collecting water is a primary activity for women and children, keeping them from attending school or obtaining jobs. This only exacerbates the poverty that leads to water stress in the first place.
- Lack of sanitation infrastructure means that much water in LDCs becomes too polluted for healthy human consumption. Populations are sickened and die in numbers unheard of in the industrial world. This further holds back development.

A US Army Sergeant gives a young Pakistani girl a drink of water.

Some of the poorest nations in the world bear the burden of being located in the driest parts of the planet. Even if these countries were able to develop the infrastructure and capacity to manage water supply and demand, they have little to work with. This is especially true in the arid regions of North and Sub-Saharan Africa and the Middle East where much of the world's anticipated population growth will occur.

Population trends in the developed world also exacerbate water stress. In the US, for example, current demographic patterns show more Americans moving to places without enough water, such as Arizona, Nevada, California, and Colorado.

In addition, *rural to urban migration is producing water stress*.

- People often think of the rural poor living in desert areas when they think of water stress, and this is certainly part of the picture. But the urban poor fare just as badly.
- Rapid urbanization has brought people to cities that cannot handle their water needs. In the growing number of megacities in the world, informal settlements such as slums and shanty towns receive little municipal help in getting the water they need and disposing of sewage. This creates its own acute experience of water stress as scarce supplies become degraded.
- A full 60% of global population growth between now and 2020 will occur in Africa and Asia; these regions' urban populations are expected to double.

Water Supply and Consumption Out of Sync

The OECD estimates that 2.8 billion (or 44%) of the world's people currently live in areas experiencing water stress. Projections based on overall population growth and the continuation of current consumption patterns indicate this figure could rise to 3.9 billion by 2030.

In sum, there is not enough water of the form and quality we need, and this deficiency is not likely to be remedied soon. What are the implications of this water shortage?

Short-Term Implications

- Most urgently, it means that 1.1 billion people in the world lack access to safe water and 2.6 billion lack adequate sanitation. There are 3.6 million deaths each year from water-related illnesses, of which nearly 2 million are children.
- This is not only tragic; it is an enormous waste of human potential and talent. It is estimated that water-related diseases, deaths, and loss of productivity shaves between 2% and 5% off the Gross Domestic Product of many LDCs, which may be more than they receive in aid.

Long-Term Implications

- Population growth is expected to continue at least until mid-century, with its attendant and increasing contributions to water stress described above.
- In addition, much that is done to address water stress in the short-term creates new problems in the long-term. Dams and other man-made attempts to manage water flows can damage the environment and impact the water cycle.
- The natural environment itself needs to be counted as a water consumer for the health of ecosystems, but the environment is at a disadvantage when competing with human requirements.
- There is a climate change overlay to water stress that cannot be ignored. Water conditions are changing in ways that we cannot fully predict.

Sonora Desert, New Mexico. Courtesy Tomas Castelazo.

- Economic development results in more water-intensive lifestyles. The average American uses 150 gallons of water per day, 50 times what the average Ethiopian uses. As economic development spreads, water conservation and development efforts are expected to parallel energy conservation and development as a technological and intellectual priority worldwide.

Water and Human Development: The Millennium Development Goals

At the turn of the 21st Century, the international community laid out a global anti-poverty agenda known as the Millennium Development Goals or MDGs. The MDGs are a set of eight key objectives related to development that provide a comprehensive framework for addressing the root causes of poverty by the year 2015. MDG 7 (Ensuring Environmental Sustainability and Reversing the Loss of Environmental Resources) explicitly mentions water issues. Its target is to reduce by half the proportion of the world's population without access to water and adequate sanitation.

However, as illustrated in a 2006 UN Human Development Report, *the achievement of all the MDGs is to some extent dependent on water*, though the role of water often goes unstated. Consider these examples:

MDG	Role of Water
1 – Eradicate extreme poverty and hunger	Preventing disease and loss of productivity, freeing up women and girls to go to school and work Growing nutritious and adequate food Averting prohibitive costs of purchasing water Contributing to industry
2 – Achieve universal primary education	Eliminating time-consuming water procurement to allow children to attend school and parents to pay attention to their schooling Sanitation facilities for girls that encourage school attendance Better health for better school attendance
3 – Promote gender equality and empower women	Reliable, convenient water supplies mean that generations of women are freed from onerous water procurement and can pursue education, training, and employment in numbers commensurate to men Less water-related disease means less time spent caring for the sick Separate quality sanitation facilities enhance sense of personal dignity Less maternal mortality
4 – Reduce child mortality	Most diarrheal deaths are preventable with improved water access and quality Other water-borne and water-related diseases can be reduced with better access to clean and adequate supplies
5 – Improve maternal health	Drastically reduced water-related diseases Less diversion of health care dollars for preventable water-related illnesses Better childbirth conditions
6 – Combat HIV/AIDS, malaria and other diseases	Less incidence of disease, better outcomes for the sick Water for making formula for the babies of HIV-positive mothers to prevent transmission Less dirty standing water means fewer mosquito breeding grounds
7 – Ensure environmental sustainability and reverse the loss of environmental resources	Protection and preservation of water supplies is key to ecosystem health and combating climate change
8 – Develop a global partnership for development	See all of the above. Global development and progress on global inequalities are not possible without attention to water.

Adapted from The UN Development Report, 2006: *Beyond Scarcity: Power, Poverty, and the Global Water Crisis*, p. 22-23. http://hdr.undp.org/en/media/HDR06-complete.pdf

Water as a Human Right

If water is thought of strictly as a *commodity*, principles of efficiency would apply to its distribution, and price would be a reasonable way to influence consumption. Many believe that if the price of water reflected its true value, people would be motivated to use it more efficiently. In developed countries whose citizens use considerably more water than is sustainable, and who can afford to pay for water, these principles may indeed be one factor in creating a s

ustainable water policy. But in a broader sense, water is not a commodity; it is a *human right*.

International Human Rights Standards

The following international human rights standards reiterate that access to clean water is a fundamental necessity for a healthy life, and as such is a human right:

- *The Constitution of the World Health Organization* stating that "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being." (WHO, 1946)
- *The Universal Declaration of Human Rights* under which people are said to enjoy a right to a "standard of living adequate for their health and well-being." (UN, 1948)
- *The International Covenant on Economic, Social, and Cultural Rights*, primarily Article 12.1 whereby all people have a "right to the highest attainable standard of physical and mental health," and the 2000 General Comment on the Covenant specifically including the "underlying determinants of health, central among these safe water and adequate sanitation." (UN, 1948, 2000)
- *The Convention on the Rights of the Child*, primarily Article 24 affirming children's right to enjoyment of the highest attainable standard of health and the responsibility of states to provide the basics contributing to this standard, including clean water. (UNHCR, 1989)
- *The UN Committee on Economic, Social, and Cultural Rights* declaration that "the right to water clearly falls within the category of guarantees essential for securing an adequate standard of living, particularly since it is one of the most fundamental conditions for survival." (UN, 2002)

Creative Commons ShareAlike 2.0. Courtesy Angela Sevin.

Schoolchildren in Ngchoni, Kenya.

Why a Human Rights-Based Approach to Water?

Why does defining water as a human right make a difference? The World Health Organization makes the following argument:

> "Ensuring that access to sufficient safe water is a human right constitutes an important step toward making it a reality for everyone. It means that:
>
> - Fresh water is a legal entitlement, rather than a commodity or service provided on a charitable basis;
> - Achieving basic and improved levels of access should be accelerated;
> - The "least served" are better targeted and therefore inequalities decreased;
> - Communities and vulnerable groups will be empowered to take part in decision-making processes;
> - The means and mechanisms available in the United Nations human rights system will be used to monitor the progress of State Parties in realizing the right to water and to hold governments accountable."

A water source for residents in Mwamongu, Tanzania.

Water Health, and Nutrition

Water for Drinking, Cooking, and Washing
Statistics: Who Has It, Who Doesn't -
Standards and Definitions: What is Acceptable? -
Is Bottled Water a Solution? -

Water for Sanitation
Statistics: Who Has It, Who Doesn't -
What it Takes -

Water Pollution and Contamination
Human Costs -
Financial Costs -

Case Study: Cholera and the World's Most Vulnerable Populations

Water for Agriculture and Nutrition
The Green Revolution -
More Crop Per Drop -
Current Trends -

Courtesy McKay Savage.

A woman carries water home in India.

Overview

Access to clean, safe water and adequate sanitation impacts every aspect of life. People's lives depend on it: a person can only survive three days without drinking water; nutrition is dependent on water since the food we eat requires water to grow; good health is dependent on water since many of the world's diseases are caused by contaminated water being consumed and used in households.

The discrepancy between the amount and quality of water available in the developed and developing worlds can be extreme. The optimum per capita consumption of water is considered to be approximately 13 gallons per day, for drinking, cooking, washing, and sanitation. The average American uses ten times this amount; the average African uses one tenth.

People who are dehydrated, malnourished, and/or sick from water-related diseases cannot work, cannot adequately care for their families, cannot go to school, and therefore cannot build vibrant economies. Health care costs eat up household and national budgets; enormous human and financial resources are wasted. Current thinking on human development, as expressed in international anti-poverty priorities such as the Millennium Development Goals (MDGs), is increasingly recognizing the centrality of water for the fulfillment of human potential. This is true especially where women and children are concerned – one child dies every 15 seconds from a water-related illness; worldwide, women and girls spend almost 200 million hours each day seeking and fetching water.

Water for Drinking, Cooking, and Washing

Drinking, cooking and washing are water's most basic and important uses. *A person can only survive three days without drinking water*; the quality of that water can mean the difference between life and death.

Statistics: Who Has It, Who Doesn't

- Approximately 1.1 billion people currently lack access to quality water.
- Of this number, 90% live in Africa and Asia.
- Seventy-percent live in just 11 countries: India, China, Indonesia, Nigeria, Bangladesh, Pakistan, Ethiopia, the Democratic Republic of Congo, Vietnam, Brazil, and Afghanistan.

Progress has been made in this area over the past decades. Global targets contained in the MDGs related to water for human consumption (drinking and washing) are on track to be met, but regional inequalities persist.

- By the year 2015, most experts predict that more than 90% of people will use an improved drinking water source.
- Sub-Saharan Africa will likely not meet the target, and other regions such as the Middle East and South Asia may experience backsliding due to population growth and increased urbanization.

Standards and Definitions: What is Acceptable?
According to the World Health Organization (WHO), water for human consumption should be sufficient, safe, accessible, and affordable.

A man cleans a well during a community clean-up day in Yaounde, Cameroon.

Sufficient:

- Between a half gallon and one gallon of water per capita per day is recommended for direct consumption and as an additive to foods and other liquids. However, climate, the nature of one's diet, and the type of work a person does all affect minimum water consumption needs.
- One and one-half gallons of water are required daily for cooking, including washing and preparing food, and washing cooking utensils.
- Two gallons are needed for hygiene and sanitation.
- Thus, an absolute minimum of four gallons a day meets the target of basic sufficiency, though almost four times this amount is recommended.

Safe:

- For water to be potable, or safe to drink, it is treated to eliminate contaminants. These contaminants may include naturally-occurring heavy metals and arsenic that leak from the earth into shallow groundwater, as well as man-made contaminants such as pharmaceutical and chemical residues from domestic, industrial, and agricultural sources.
- Water used for hand-washing and food preparation must also be treated in order to prevent contamination and water-borne diseases. People who drink bottled water but use unimproved sources for cooking and personal hygiene are included in totals of people lacking quality water.

Accessible:

- Ideally, water for consumption should be potable running water.
- The amount of time an individual must spend in round-trip travel in order to reach treated water is important in calculating accessibility. Water requiring more than a 1 kilometer or 30 minutes round trip is considered inaccessible.
- The time it takes to fetch clean water in many developing countries prevents people from going to school or work, which reinforces the cycle of poverty. The physical burdens of carrying gallons of water over long distances also take their toll on the body.
- Water that is improperly stored (where it can be contaminated and/or serve as a breeding ground for mosquitoes) is not considered accessible or safe.

Affordable:

- Affordable water should take no more than 3% of household income to procure.
- In many poor countries where people must purchase water from vendors, this figure rises to 10%, a cost not tolerated in the developed world.

Is Bottled Water a Solution?
Travelers to many countries in the world are cautioned not to drink the local water. Bottled water is often the recommended alternative. Individual water treatment kits (filters, tablets) are also an option, but much less commonly used by the average traveler.

But what if you live in a country where the average water source is not considered safe? Is bottled water a daily solution? Probably not:

- *Bottled water is expensive*. The daily cost of using bottled water would be prohibitive for most of the world's poor.
- *Bottled water used for drinking alone does not solve the problem*. To fully realize the benefits of using bottled instead of local water sources, a person would have to use the packaged water for hygiene and sanitation as well, and this would necessitate a volume of bottled water that is not viable for most people.

Courtesy Brett Weinstein. Creative Commons Attribution ShareAlike 2.5.

- *Bottled water harms the environment and can worsen water stress.* The plastic required for bottles requires a tremendous amount of water-intensive energy to produce. Filtering the water that goes into these bottles ironically requires more water than is packaged – an estimated three to nine gallons of water is required to filter each gallon of bottled water. Mining aquifers and springs to find this water is often done unsustainably. Furthermore, the used bottles clog landfills.

Water for Sanitation

Water for sanitation, or *the removal of human waste*, is no less important than water for consumption. Improved sanitation is defined by the UN as "the existence of facilities that ensure hygienic separation of human excreta from human contact."

In poor countries, *sewage* is the source of much of the contamination of water used for drinking and washing. Simply coming into contact with raw sewage and untreated human waste can be deadly, especially for children who play in dirty streets and then absorb pathogens through their hands, noses, and eyes.

Statistics: Who Has it, Who Doesn't

- Currently 2.6 billion people in the world lack access to adequate sanitation facilities.
- Most people in industrialized countries have had access to improved sanitation for many decades, and 1.1 billion people in the developed world have obtained access to sanitation over the past 20 years.
- Multiple sources estimate that progress on this MDG indicator will fall short of its goal of securing improved sanitation for 77% of the world's population, and will succeed only in reaching 67% .
- The rural and urban poor fare the worst as facilities are non-existent and/or overwhelmed.
- The least progress has been realized in Sub-Saharan Africa, South Asia, and the former Soviet Union. The situation is especially dire in South Asia where a large percentage of the world's population resides and where only one in three people has access to sanitation.

What It Takes

Most experts agree that critical improvement in sanitation is about more than money; it is also about recognition and discussion. Human waste is not a topic most are eager to discuss, and therefore public analysis and a commitment to improving the situation can be lacking in international planning and funding bodies. This is also an issue at the household and community levels, where conversations need to take place to educate people about hygienic practices. There is much at stake in getting people talking:

- Helping people avoid contact with feces through basic disposal systems such as toilets and decontaminating waste water can save millions of lives.
- Having hand-washing facilities near toilets are estimated to reduce diarrheal deaths by one-third.
- In many developing countries, the lack of adequate, gender-separate facilities keep girls from going to school.
- In some countries where no private facilities exist, women and girls often wait until nightfall to travel outside the safe confines of villages in order to defecate.

Educating people about these realities would yield significant returns. In an Opinion piece for the *New York Times* entitled "Send in the Latrines," sanitation expert Rose George writes of the challenge associated with moving sanitation issues into the forefront:

> A substance common to us all, and as vital to life as breathing, has become unspeakable, and particularly in the polite and powerful circles that could do something about its deadly effects. There's no place for squeamishness when…diarrhea trails only pneumonia as the biggest killer of small children in the world, greater than tuberculosis, AIDS or malaria, in numbers equivalent to a jumbo jet crashing every hour.

The good news is that *investment in sanitation yields a healthy return*. A study by the World Health Organization (WHO) estimates that every $1 investment in sanitation results in a benefit of anywhere between $5 and ten times that amount.

Water Pollution and Contamination

The prevalence of contamination (from man-made pollution and waste to naturally-occurring toxins), and the wide range of ways contaminated water can enter the human body are staggering. Every day, people are put at risk through:

- Drinking contaminated water;
- Eating food that was grown, washed, or prepared using contaminated sources;
- Eating food prepared in bowls or with utensils washed with contaminated water;
- Acquiring germs from people's hands that are then absorbed by eating, rubbing eyes, wiping noses;
- Bathing and washing in unhygienic water; and
- Providing and receiving medical care in unsanitary environments.

Human Costs

The *human costs* of people consuming and coming into contact with unsafe water are dire:

- *Water-related diseases are one of the leading causes of death worldwide*. Over 3 million people die each year, nearly all in developing countries. In some poor countries, diseases resulting from contaminated water comprise 80% of the total disease burden. It is estimated that up to half of all hospital beds in the world are occupied by victims of water contamination.
- *The biggest killer is diarrhea contracted from microorganisms in water contaminated by sewage*, resulting in 1.8 million child deaths per year. In places like Sub-Saharan Africa and South Asia, up to half of all cases of malnutrition are caused by diarrhea. It is estimated that diarrhea alone costs the world 52.5 million lost years of healthy life. Nearly all diarrheal deaths are preventable. In fact, mortality from water-contracted diarrhea was largely eliminated in the developed world by 1925, as technological advances secured widespread access to improved water and sanitation facilities.

A dump site next to the Ciliwung River, Indonesia. Courtesy Danumurthi Mahendra.

- *Other major water-related diseases include*: aresenicosis and flurosis (from prolonged exposure to naturally-occurring arsenic and fluoride, respectively, in groundwater); cholera and typhoid (water-borne bacterial infections); guinea worm disease, intestinal worms, and schistosomiasis (from ingesting water-borne larvae); and trachoma (eye infections from dirty water).
- *Patients with diseases not directly related to water such as HIV/AIDS are impacted by unsafe water* because they are more susceptible to complications and infections.
- *Dirty water (standing in puddles or stored) is a breeding ground for mosquitoes that go on to spread diseases such as malaria and encephalitis*. The UN estimates that 60% of global cases of malaria and 80% of malaria deaths in Sub-Saharan Africa (nearly 1 million per year) are related to water storage.

Although people living in LDCs experience more water contamination and higher risk of illness and death related to poor quality water, this is not a problem exclusive to poor countries. See the recent *New York Times* series entitled "Toxic Waters" for an examination of polluted waters in the US that routinely sicken and kill Americans.

Financial Costs

Tremendous financial costs are contained in all these statistics – in lost school days, lost work days, and health care costs.

- The UN estimates that simply meeting the MDG goals related to water and sanitation would save $7.3 billion per year in health care costs.
- Billions more would result from increased productivity in terms of healthy adult working days,

including the increased productivity that would result when women are freed from the onerous burden of seeking out and transporting water, and could use their time in other ways. (Maude Barlow includes in her book, *Blue Covenant*, the shocking statistic that the women of South Africa collectively walk the equivalent of the distance to the moon and back 16 times a day for water.)

Case Study: Cholera and the World's Most Vulnerable Poopulations

Cholera is an intestinal disease caused by ingestion of a parasite found in contaminated water and food. Once a global scourge akin to the plague, cholera has now largely been eliminated in the developed world. Today, it is a disease associated with desperation and poverty. In most epidemic situations, it affects those who have already been hit with misfortune – those living in poor countries, refugees of war and conflict, survivors of natural disasters. *It is the news story after the big news story, hitting vulnerable populations after major disruptive events, seeping in where there is already incredible hardship*. Examples include massive infections from dirty water after the Asian Tsunami, outbreaks in refugee camps in Rwanda in 1994 and today in Darfur and Iraq, and everyday transmissions in crisis-ridden Zimbabwe. In a particularly cruel twist of fate, children who are orphaned in these societies are often at highest risk.

Cholera's victims are often children who play in dirty water contaminated by fecal matter. Without proper facilities for hand-washing, humans transmit the bacteria through food and water, often infecting entire families and communities through what often begins with inadvertent contact with the contaminant. The disease kills through severe dehydration resulting from watery diarrhea. There is no vaccine; simple rehydration therapies often are out of the reach of cholera's victims who usually live in remote, poor, or destroyed environments.

It is of great concern to health experts worldwide that cholera appears to be on the rise. The WHO notes that rates of infection rose nearly 80% from 2005 to 2006, reaching levels not seen since the 1990s and affecting countries where the disease had previously been largely eradicated. In the case of Zimbabwe, for example, the disease has made

Medicins Sans Frontiers treats a young child suffering from cholera in Zimbabwe. Courtesy www.Sokwanele.com.

a giant comeback in recent years, one result of the failed economic and social policies of President Robert Mugabe. As public health and sanitation facilities falter in the failing state – some reports predict that fully half of Zimbabwe's 12 million people are at risk following epidemics in 2008 – the upcoming rainy season is expected to see another resurgence of the disease.

It is estimated that only 10% of cholera cases are reported due to chaos and low public health capacities in affected areas; thus, real global trends are likely even more extreme. These trends are a travesty to many in the public health and development field because cholera infections can be prevented easily through access to proper sanitation facilities and hand-washing.

Water for Agriculture and Nutrition

Nutrition is a staple of human existence, and water is essential for the production of food through agriculture – the cultivation, irrigation and processing of crops, and the maintenance of livestock. Globally, 70% of all water is used in agriculture, but this figure can be as high as 90% in developing countries.

The global population is expected to reach 9 billion by the year 2050. Obviously as the population grows, there is a concomitantly higher demand for water as well as food. And as populations become more prosperous, the foods they consume will likely be increasingly water-intensive. Can adequate food and nutrition be produced using less water? What will be the effects of global warming? These will be critical questions going forward in a world of water stress.

The way water is used for food production is a classic example of the tragedy of the commons; it is tough to fault

anyone for trying to feed their families or produce food for export to hungry people, but when everyone pushes water supplies beyond their replenishment rate, ultimately none of these farmers, big or small, will be able to feed anyone.

The Green Revolution

The big story here begins with innovation in agricultural practices over the last century (concentrated in the 1960s) that have largely fed the world, albeit while doing serious damage to the world's water supplies.

- For centuries, crops in most places were rain-fed (using green water), and were thus dependent on seasonal and regional variability of precipitation. Growing seasons were short, and output was limited.
- New widespread irrigation practices took blue water from rivers, lakes, and aquifers to sustain crops year-round and substantially boost output. Crop yields from irrigated land are typically up to four times more substantial than their rain-fed counterparts.
- Chemical fertilizers and pesticides were developed that exponentially increased total output and crop variety.
- The Green Revolution made it possible to feed a growing world population and, in turn, *ended up encouraging population growth*. The result was more people eating more and different foods, most of them highly water intensive to produce.

The toll on the water cycle brought on by the Green Revolution has been significant, from overuse and the unsustainable use of water to the pollution of water from agricultural chemical and organic run-off. Water stress could lead to food stress as irrigation sources dry up.

More Crop Per Drop

A big part of a potential solution to easing water stress will be *increasing the water-efficiency of agriculture*.

- Different types of food require varying amounts of water to irrigate and process.
- As water stress spreads, farmers must increasingly pay attention to the level of productivity (or efficiency) of the water they use to grow and harvest their crops, when determining what to grow as well as in managing their crop yields.
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Camels walking near Lake Assal, Djibouti. Courtesy Charles Fred.

- Crop per drop efficiency would suggest that farmers in arid regions not grow water-intensive crops, but that these be grown in wetter areas of the world.

The success of crop per drop efficiency, however, depends on people being able to get crucial food imports at stable prices. When global food markets falter, as they did in 2008, the trend often swings back to self-sufficiency over water efficiency. Countries begin growing food crops that they do not have the sustainable water supplies to support. See the 2008 *New York Times* series entitled "The Food Chain," which illustrates how this desire for food self-sufficiency has led countries such as Djibouti to grow rice (a highly water intensive crop for which it is not suited) in solar paneled greenhouses, fed with groundwater and cooled with seawater, making it the most expensive rice in the world.

Current Trends

Below are some trends to watch relating to agriculture and water:

1) Meat consumption is rising all over the world.

- Meat requires ten times the amount of water per calorie to produce that plant-based food does.
- With an increasing number of meat-eaters in the world, the demand for this commodity will likely continue to grow.

2) Non-food crops consume a great deal of water, expanding the water footprint of the agricultural sector while not directly feeding anyone. Profits from growing and selling cash crops such as these do allow people to purchase food from other sources, but as more land (and more water) is devoted to non-food crops, food supplies and prices are impacted.

- These cash crops include cotton, a staple of many developing countries' economies, and biofuels such as

sugar and corn which are used in the production of ethanol.

- These products are water-intensive, but are often grown in arid areas.
- The fact that these crops have alternatives/substitutes, leads many to wonder if they should be the recipients of stressed water supplies.

3) There is increasing competition between small farmers and large-scale agribusinesses for limited irrigation resources. It is tough to say which are more water-efficient.

- Small farmers often have limited access to large irrigation systems and are therefore more locally savvy and nimble in their water use.
- Large industrial agriculture practices are often wasteful of water, and large conglomerates can afford not to address this waste because the resource is currently so underpriced once infrastructure is in place.
- However, small farmers in some water-stressed areas, particularly in South Asia, often desperately turn to highly unsustainable water extraction practices, such as overdrilling for wells.

4) Help for poor countries in boosting their agricultural water efficiency is lacking at a time in which it is becoming more critical.

- Agricultural aid, often known as agricultural extension assistance for Least Developed Countries (LDCs), has been decreasing over the past two decades in real terms; it has fallen by one-third since the 1990s.
- Private investment in water efficiency in LDCs is also considered inadequate. Large investments of private capital in this sector are seen as risky in LDCs where regulation, governance, and land policies are inefficient or non-existent.

http://www.flickr.com/photos/blmurch

Cattle awaiting sale in Argentina.

5) When considering water for agriculture, fishing is often not taken into account.

- As lakes and rivers dry up due to disruptions in the water cycle (man-made and climate-related), fish stocks are impacted. This is currently happening in rich and poor countries alike.
- Water pollution also negatively impacts the supply and quality of fish.
- Many people in the world depend on fish for their daily protein requirements, and many depend on the fishing industry for their livelihoods.

6) Global warming is thought to be playing a role in the increasing prevalence of droughts all over the world. Feeding a growing population with any kind of crops (water-intensive or water-efficient) is likely to become more challenging as water stress increases due to more severe droughts.

Various brands of Japanese bottled water.

Water, Economics, and Trade

Water as Key to Economic Development

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Courtesy http://www.flickr.com/photos/travir

A boy selling water to patients at a hospital in Freetown, Sierra Leone.

Overview

Water is essential to the economic development of individuals, communities, countries, and the world. Human settlement activity, from ancient times to the present, has been driven by access to dependable water sources. *Societies that flourish are generally located near water*, which can be used as an agent for human development, industry and agriculture, transport of traded goods, and cultural, social, and religious purposes. On the other hand, because water touches all these areas of economic life, water stress endangers economic activity at every level.

As the world's economy becomes increasingly interconnected, *water stress and water use become global issues*. In some areas, water scarcity is physical and related to a country's geographic location. In others, water scarcity is economic, meaning that water sources are available, but inaccessible or damaged because of lack of infrastructure, investment, and good management. Whatever the cause of the water stress, from the deserts of Sudan to the growing cities of China and India, solutions are needed to help people and businesses do more with less water.

Water as Key to Economic Development

Water is a natural resource, but also a commodity, much like oil, minerals, and timber. It costs money to extract, treat, process, and distribute; it has value as an economic input and as a facilitator or accelerant of economic activity. Numerous studies have illustrated that dependable water supplies contribute to GDP growth, and that lack of water contributes to economic stagnation and decline.

Water is needed for *individual economic development*:

- Economies are based on individuals engaging in activities that produce goods and services; these individuals must have water for their *health, survival, and lifestyle* if they are to be productive. Illness, malnourishment, and treatment for water-related diseases take an enormous economic toll on individuals and their communities.
- Individuals need *convenient access* to water so that they can spend their time working or being educated or caring for children. This is especially true for women, on whom the burden of water procurement usually falls. Water is an essential ingredient for the empowerment of women generally, and the world is coming to realize that this empowerment is, in turn, an essential ingredient for the economic development of entire countries. (See the *Global Status of Women* edition of the *World Savvy Monitor*).

Water is also needed for *economic development of communities and countries*:

- Water is used in the *direct production of goods*, both agricultural and industrial.
- Water is used to produce the vast amounts of *energy* (electricity and gasoline) that make the production of goods possible.

- Water is used to *transport* the fruits of all this production activity so they can be sold to neighboring communities or to the world.
- Even *high technology information and communication systems* depend on water to produce energy and to cool giant computer servers on which the online world depends.

Water in Consumption and Commerce

In addition to being critical to the health of workers, (see the *Health and Nutrition* section), water factors into business of all kinds. Water is:

- A central ingredient in beverages which are sold all over the world, from coffee to soft drinks to beer;
- Required to grow and process all crops, food and non-food;
- Needed to produce energy, from gasoline to electricity to nuclear power to biofuels to coal;
- Needed to cool giant computer servers on which the Internet depends;
- Used in manufacturing of all kinds to cool, heat, and clean machines;
- Critical to the transportation of goods of all kinds;
- Key to health care and medicine; and
- Central to tourism, from the allure of beaches and pools to hotels and casinos.

All these consumers are competing for a scarce resource in a world of water stress which requires trade-offs and raises the question: which precious drops yield the highest return? Sometimes the answers are not what one might predict.

An interesting illustration of this point appears in Robert Glennon's new book *Unquenchable*, in which he recounts a debate over water use in the American West. The thirsty behemoth that is Las Vegas does not usually make one think of wise water use, situated as it is in a desert irrigated by expensive blue water. Glennon makes the point, however, that the tourism industry of Vegas has a far higher return in terms of dollars per water drop (in profits and tax revenues from hotels, golf courses, water parks, etc.) than any crop grown in such an irrigated desert ever could.

Courtesy Vladimir Menkov.

Drinking water vending machines in Thailand.
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The Water-Energy Nexus

Water and energy are intimately linked, in production and consumption, and their relationship complicates notions of scarcity and conservation. Water is currently the third-largest industry in the global economy, after oil and electricity. The interdependence of these giant economic drivers is important to understand.

Water is used to produce energy:

- The most obvious, yet not the greatest, use of water in the production of energy is *hydroelectric power*. Hydroelectric power generated by dams contributes 19% of global electricity. In some countries, such as Brazil, this figure can be as high as 90%. Whereas in the US and Europe most potential sites are already dammed, in Africa only 7% of potential hydroelectric power sources are developed.
- Water is also used in the drilling, mining, and processing of *fossil fuels* such as oil and coal.
- Water is used to cool processors and material used in *nuclear power* plants – without water, this source of energy would be impossible to produce. France is dependent on nuclear power for 75% of its electricity.
- In the US and the EU, energy production accounts for 39% and 31% respectively of all water usage. These percentages are lower in developing countries, but they can be expected to increase with economic development.

Courtesy Kevin Jones

Brazil's largest hydroelectric dam, Itaipu.
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- *Foreign Policy* magazine recently noted that many *green alternatives* to conventional energy supplies are little improvement over fossil fuels when it comes to how much water they require to produce. Biofuels are water-intensive to grow. Plug-in cars use electricity from power plants that use water as a coolant. Even silicon chips that contribute to high-tech efficiencies in energy production require large amounts of water to manufacture.

Energy is used to produce and distribute water:

- A tremendous amount of energy is used to pump, treat, and deliver freshwater.
- One of the most energy-intensive pursuits in this field is *desalination* of ocean water to convert it to freshwater.
- The UN estimates that 7% of all energy production worldwide goes to *water extraction and treatment*, a figure that will significantly increase as more people in the world gain access to improved water and adequate sanitation.
- In California, water is the largest energy user in the state; it consumes 19% of the electricity produced.
- The National Resources Defense Council estimates that the collection, distribution, and treatment of drinking water and wastewater in the US uses energy that releases 116 billion pounds of carbon dioxide into the atmosphere each year – this is the equivalent to the exhaust from 10 million cars.
- Global warming, caused in part by the burning of fossil fuels to produce water, disrupts the water cycle and contributes to water stress. See the *Water and the Environment* section.

Global Economics and Virtual Water

Globalization demands coordinated policies for developing and implementing solutions to water stress. Water can really no longer be managed only at the local level – water policies in any given place affect individuals, companies, and countries throughout the world. The trans-national nature of the water cycle and of the issues leading to water stress, make the integration of water policies critical. *Globalization can be a positive force for water management*, as the world comes to have a common stake in its success.

Transportation of Goods

Moving goods around in a globalized trading system requires water. This was true centuries ago when civilizations first began to trade with each other, and it is still true today. Even with technological innovations in aviation, trucking, and rail commerce, *most goods today still travel by ship*. This puts countries with plentiful domestic waterways and access to international waters at a great advantage.

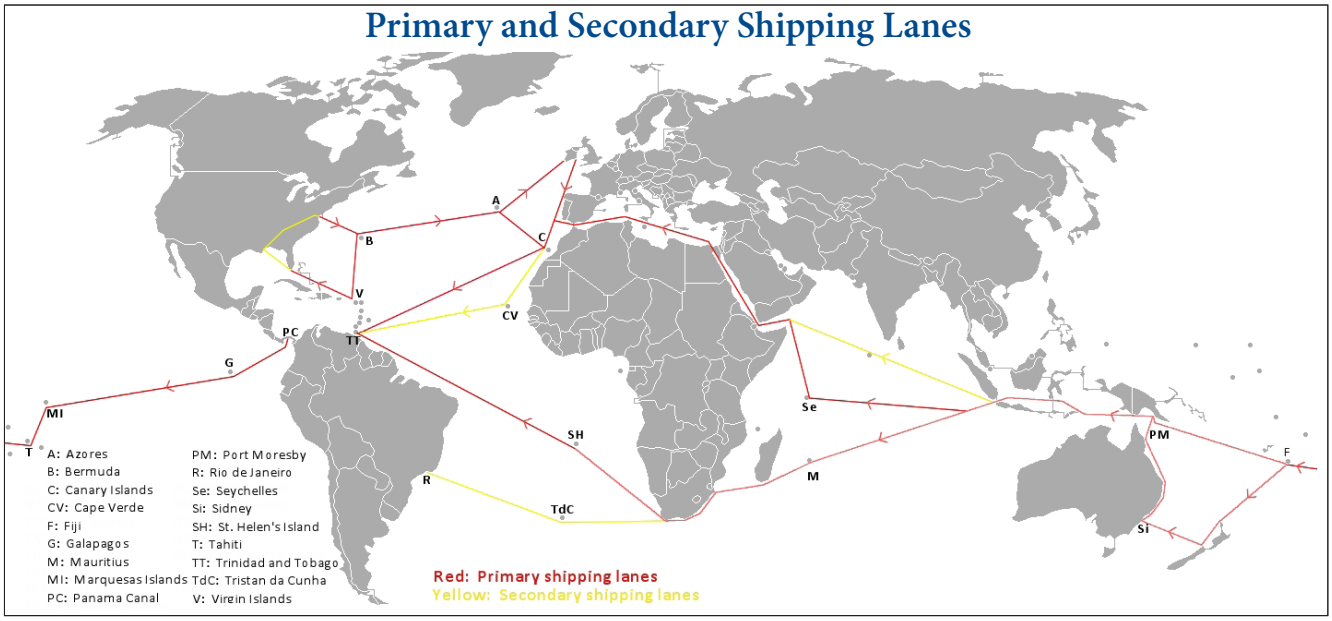
Economic giants such as the United States spend enormous resources protecting and maintaining international shipping corridors far from their borders to ensure that commercial trade is unimpeded. This requires a strong naval presence in those areas in which local politics threatens shipping; for instance, the Gulf of Hormuz off the coast of Iran and the Gulf of Aden off the coast of Somalia are both essential shipping lanes for oil coming out of the Persian Gulf and are both heavily guarded. See the *Water, Politics, and Conflict* section for more information.

The map on the following page delineates the world's major shipping lanes.

Virtual Water

Economists often speak of virtual water, an interesting concept that is increasingly entering the conversation about how countries can meet their water needs in a globalized context.

Virtual water is the water required to produce a product, usually an agricultural product. In this context, it refers to the amount of freshwater required to irrigate and process crops for export. Virtual water matters because, through global trade, water-scarce countries can avoid using their own internal water to grow crops if they can import those crops grown somewhere else using someone else's water.



The water it would have taken to produce that imported crop or manufactured product, the product's virtual water, can represent a water savings for the importing country.

Different products have different virtual water values. Below are some examples from Hoekstra and Chapagin:

Product	Virtual Water Content Per Unit
1 glass of milk	200 liters
1 potato	25 liters
1 cotton t-shirt	2,000 liters
1 egg	135 liters
1 hamburger	2,400 liters
1 pair of leather shoes	8,000 liters
1 microchip	32 liters

The importance of virtual water flows becomes readily apparent when you consider the variable figures above. In a perfect free trade world, water-scarce countries should import water-intensive crops and goods. Water-rich countries should grow, produce, and export water-intensive crops and goods. This would maximize the efficiency of the world's water resources.

For example, wheat is a water-intensive crop. It takes about 1300 liters of water to grow 1 kilogram of wheat, a common food staple. If you don't have that kind of water, you must import it from somewhere else. Consider that one kilogram of wheat is much easier to ship to a water-scarce country than 1300 liters of water. In a world where water stress and shipping capacity are both growing, this will become increasingly economically attractive.

The World Economic Forum reports that, in 2008, the Kingdom of Saudi Arabia made the choice to stop seeking self-sufficiency in wheat production. Rather, they set up an investment fund to buy land in more water-rich countries for the purpose of farming wheat for export back to the Kingdom. Other countries in South Asia and the Arabian Gulf area are pursuing similar programs. As water stress increases, some countries will out of necessity choose to reserve their valuable land for crops they can grow easily without tapping unsustainable or prohibitively expensive scarce water resources.

It is estimated that by 2030, 55% of the world's countries will depend on food imports because of water scarcity. The trade policies of nations will impact their water policies and vice-versa as water moves around the globe in the form of traded goods.

Privatization of Water

There are some who argue that one way to increase the efficiency of water use is to put it under private (for-profit) control, so that markets determine where it goes, in what amounts, and what it will cost.

Right now, *the water industry is a hybrid mixture of public and private control.*

- If you look across the spectrum of activity required to extract, treat, and deliver freshwater, you will find

that usually some parts of the process are owned and/or managed by the public sector, some parts are contracted out to private companies and vendors, and some parts are an indistinguishable mix of subsidies, public-private investments, and market forces.

- In some places the public sector (government) may have a monopoly because it controls treatment systems and pipes.
- In other places, private industry may have a monopoly, as in areas where water vendors sell to households that are not reached by public utilities.
- Usually, it is a mix. Incentives to invest in water are great for both the public and private sectors – for the public in terms of the large yield in human development from small improvements (see the *Water, Health, and Nutrition* section for more information), for the private in terms of money that can be made from distributing a valuable universally-used resource.

History of Privatization

- Widespread privatization efforts grew in the late 20th Century when international financial institutions such as the World Bank and International Monetary Fund required countries seeking assistance to deregulate, abolish subsidies, and even sell much of their water systems and infrastructure to private investors.
- The rationale was that privatization would result in more efficiency and less corruption. Private investors would have the wherewithal and the incentive to build, maintain, and upgrade expensive water facilities in order to turn a profit, whereas governments in many of these countries had been doing a poor job of stewarding their publicly-financed (and often starved) water industries.
- These privatization programs continue today in many heavily indebted countries which continue to seek loans and aid from international institutions.
- It is estimated that around 15% of the almost 4 billion people in the world who do have access to clean water and sanitation get it from a private industry.

The Debate Over Privatization of Water

On one hand, many would *say privatization has produced the intended benefits*.

An out of order water fountain next to a vending machine selling water. Courtesy Nathan Rein.

- Many water systems in poor countries *would not exist but for the private funding* mandated by international lending institutions. Cash-strapped governments simply had no choice but to outsource expensive up-front costs of providing water to their citizens. Governments overwhelmed by development needs are often unable to efficiently manage the complexity of water extraction, treatment, delivery, and finance.
- When people must purchase their water through the private market, cost serves an important *conservation function*. People are less likely to waste a resource for which they are paying a market rate, as opposed to a rate heavily subsidized by the government.

On the other hand, *privatization is often seen as having failed much of the world's poor*.

- In their efforts to recoup often significant investments, *private water companies usually increase prices on the water they provide*. In some cases, these price increases have been so hefty as to knock poor consumers out of the market entirely, leaving them, again, with no access to water because they cannot afford it even when it is physically accessible.
- The UN Development Program notes that privatization has hurt many in the developing world, where poor people pay some of the highest prices for water. For example, the poorest 20% of households in El Salvador, Jamaica, and Nicaragua spend up to 10% of their income on water.
- Privatization schemes often appear undemocratic in that they *exclude the citizenry from the decision-making processes* in what was formerly a public utility.
- Privatization often results in *local job losses* as multinational corporations and conglomerates both reduce work forces through improved efficiencies and transfer jobs to workers in other countries.
- When profit is a motive in water provision, less lucrative services often suffer. Efficiency dictates that

resources go where they produce the highest return – this means *poor rural areas and other hard-to-serve customer bases get lower priority*.

- In some cases, private companies have retreated from particularly poor areas where returns on investment have been low or from areas where local resistance and protests against privatization have made for bad public relations – see below. In these cases, the cost of picking up the pieces is often higher for local governments than it might have been had the private companies not been there in the first place.
- Cases in which privatization has worked well usually include special *voucher programs* whereby purchases for those unable to afford water are subsidized by the government or aid organizations.

Many argue that water is a human right and as such, it should not be treated like a commodity. However, a number of sophisticated investors believe that water could become the "new oil," and this view is spurring considerable investment in the industry.

Going forward, it is unlikely that entire water systems will reflect a pure form of either private or public ownership. Governments at all levels will likely still maintain a role in water regulation and management, no matter how the industry itself is funded. The challenge is integrating all of the stakeholders so that water quality and access are maximized.

Case Study: Privatization of Water in Bolivia

Bolivia is South America's poorest country and the site of one of the world's most notorious and controversial water privatization programs.

In the 1990s, under World Bank guidance, the water systems of some of Bolivia's poorest regions were put up for sale to private investors. In the area of Cochabamba, the winner of an uncontested bidding process was a subsidiary of the US company Bechtel. The immediate effect of Bechtel's water investment and management was, as promised, expanded access to water by many previously unserved communities. However, when the company took over local wells and informal pumps as well as the public system infrastructure, many consumers were priced out of the market, unable to pay the increased water rates, which in some cases had doubled.

A view of Cochabamba, Bolivia. Courtesy C. Maranon.

In 2000, riots broke out in Cochabamba as protestors filled the streets. Violence shook the confidence of the local government and international investors. Bechtel was forced out, resulting not only in chaos in water delivery in the area, but dealing a serious blow to foreign investment in the country.

Undeterred, the French water giant Suez Company picked up a lucrative concession to provide water to the El Alto area of the Bolivian capital La Paz. In 2005, however, residents of El Alto also took to the streets to protest high water rates, forcing the government to cancel the Suez contract. In the wake of the ouster, tens of thousands of households were left with no water while the local government attempted to regroup on water delivery.

The Nation magazine featured the El Alto Water Revolt as a quintessential "consumer rebellion" – against the principle of water privatization, against the results of water privatization (high prices), and against the anti-democratic nature of water privatization.

Bolivia's example illustrates the complex problems inherent in applying private market solutions to what are essentially public sector problems. The most successful solutions as water stress spreads globally will probably be those to which the public and private sectors both contribute.

See:

http://www.thenation.com/doc/20050214/shultz

http://www.newyorker.com/archive/2002/04/08/020408fa_FACT1?currentPage=all

http://www.pbs.org/frontlineworld/stories/bolivia/thestory.html

Courtesy of NASA

Water and the Environment

Icebergs breaking off of glaciers in Greenland. Courtesy Mila Zinkova

Overview

We are increasingly coming to appreciate how human activity affects our natural environment – how we impact the fragile balances and processes of ecosystems. Often, human manipulation of the environment produces what is known as a *feedback loop*, meaning that humans alter their surroundings in search of resources, only to find that their manipulations have harmed the natural systems that provide those resources in the first place. Scarcity drives people to find new ways of manipulating natural systems, resulting in more environmental disruptions. There are many who believe that we may be reaching a tipping point, where natural systems on which we depend for clean air, adequate water, and food will be irreversibly damaged. In this section, we will examine how the health of the environment impacts the water cycle and what role humans play in this particular feedback loop.

There are more people on the planet than ever before, using water in record volumes. Not only does this mean that more demands are placed on the finite amount of freshwater produced by the earth through the hydrologic cycle. It means that the freshwater supplies we do have are increasingly polluted and harder to capture. It means more "hydrologic shocks" that impact not only humans directly, but all ecosystems on which humans depend. It may mean millions of climate refugees as coastal regions all over the world become uninhabitable. See the *Migration* edition of the *World Savvy Monitor* for more on climate refugees.

Feedback Loops: The Basic Problem

Human consumption of water and interaction with the water cycle both contribute to water stress in a complex dynamic that has resulted in environmental damage and risks to human security.

- *Humans are directly disrupting the hydrologic cycle in the way they use water* through the unsustainable use of freshwater, pollution of water at all stages of the cycle, and manipulations of water flows.
- Disruptions in the hydrologic cycle are resulting from *climate change*. This climate change, or global warming, is thought to be caused by human-driven carbon dioxide emissions.
- A disrupted cycle means that *we can no longer predict as accurately where water will be, in what form, and in what quantities*. We depend on our knowledge of how the hydrologic cycle has worked over time, but climate change undermines the reliability of this information in forecasting future weather patterns and freshwater flows.

How Humans Directly Disrupt the Water Cycle

Below are some of the ways in which humans directly disrupt the water cycle:

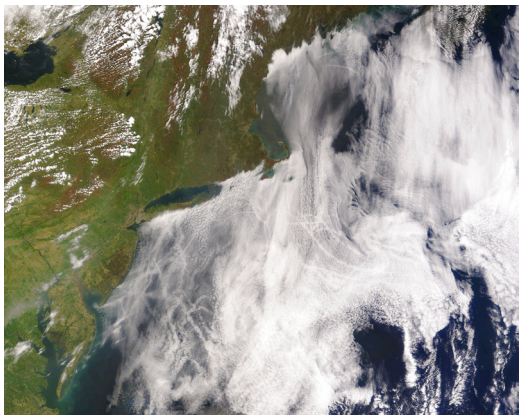
- *Pollution* that harms the quality of water in all its three forms: liquid, gas, and solid. When it finally ends up as freshwater, its quality is often compromised.

- *Depletion of aquifers* (underground water) by over-extraction and drilling for freshwater. Many aquifers are recharged by annual rainfall and melting of the snow pack, but humans are using water of aquifers faster than it can be replenished. This means there is less water available annually in these previously abundant underground lakes. It also means that water is harder to access because water tables fall (i.e., you have to go deeper and deeper to get it). Flows to rivers and lakes, and even back to the ocean, can also be affected by low water tables.
- *Damming of rivers and streams* that impedes water flow and harms fish and other marine life. Water that is trapped in lakes doesn't move through the recycling process as efficiently.
- *Urbanization* that has replaced porous soils with concrete, removed trees and plants that control water-runoff, and stressed water supplies by concentrating human activity. That many of these cities are coastal and built on wetlands and marshes only further damages ecosystems that help the movement of water through the cycle.

How Humans Indirectly Disrupt the Water Cycle: Climate Change

Below are some of the effects of climate change:

- Global warming *melts the environment's natural water banks* – glaciers, ice caps, and snow pack. At higher temperatures, water moves more quickly from its solid to liquid form. In the short-term, this can cause floods as rivers and streams swell from fast-melting snow and ice. In the long-term, it is like spending your savings from a bank; it takes a long time to replenish what is withdrawn.
- Melting snow *changes the composition of the oceans*. Oceans depend on a fragile balance of fresh and seawater, cold and warm water. Disruptions affect marine life and ecosystems vital for the health of the oceans and thus the health of the hydrologic cycle. These changes to the ocean's composition also affect currents and weather patterns and can lead to increased volatility in the form of tropical storms and other extreme climate events.
- Glacial melt is expected to contribute to *rises in sea levels* as well, as more volume in the ocean from melted snow and ice pushes water up and over existing sea-land boundaries. This destroys fragile river delta areas as freshwater is overwhelmed by sea water.



Satelite image of shiptracks (clouds created by the exhaust of ships' smokestacks) over the Atalntic Ocean off of the East Coast of the United States. Courtesy of NASA.

- Climate change has resulted in *warmer temperatures* in many bodies of water. Warmer water, whether in oceans or lakes and streams, evaporates faster than cooler water, speeding up the hydrologic cycle. This can result in the disappearance of freshwater before it can be used. Rivers and lakes can run dry even before they make it to the ocean, effectively taking water out of circulation in this part of the cycle.
- *Weather pattern disruptions* brought on by climate change mean that precipitation (rain or snow) patterns change, with resulting desertification and drought in some areas, floods in others. Both mean that water is not efficiently returned to the cycle after it falls from the sky. In a flood, the ground as well as surface lakes and rivers cannot absorb all the water that falls in a short period of time, and therefore precious rainfall is wasted as the run-off flows quickly back to the ocean. In droughts, the ground becomes so hard that when it does rain, the moisture is poorly absorbed, with the same result.

The World's Oceans

Although the conversation about humans and water is mostly about freshwater, it is also important to understand the oceans and their vital place in the hydrologic system.

Oceans cover 70% of the earth's surface. Their importance to life on earth cannot be overestimated.

- Oceans provide 70% of the oxygen needed for life on earth.

- They act as a "carbon sink" for harmful greenhouse gases.
- Oceans are home to entire ecosystems of microorganisms, plants, reefs, animals, fish, and other living creatures; they contain ecosystems that serve critical functions in numerous natural cycles.
- Through shipping channels, coastal economic hubs, and tourism, they support a large amount of human activity.
- *Humans have been interacting with the oceans* since the beginning of human life. Human settlement was often concentrated around oceans, and trading and fishing have supported mankind for centuries. In recent years, however, the effects of this interaction have grown to the point where the consequences can be profound and long-lasting.
- Changes in the acidity of the water through increased carbon emissions harm vital marine life.
- Warming the water as a result of greenhouse gases disrupts marine life cycles, species diversity, and currents on which the health of the ocean depends.
- Polluting the water with chemicals, debris, and waste, as well as through aquaculture (fish farming), alters natural species variety and destroys aquatic organisms.
- Overfishing and trawling leads to species extinction and compromises ecosystem balance at various depths of the ocean.
- Development of coastal wetlands causes the destruction of fish and shellfish, and destroys an important buffer to coastal flooding.
- Offshore oil drilling can harm marine life and pollute water and wetlands.
- Desalination plants that turn saltwater into freshwater can kill ocean life in the extraction process and alter the fragile chemical balance of oceans. It can also harm rivers and streams with the salty residue created in the desalination process.
- Large commercial ships and cruise ships that displace enormous amounts of water as they move through the oceans disrupt marine life and contribute to pollution.

The Environment as a Consumer

Experts have started constructing models based on the growing recognition that *water must be set aside for environmental health*. This means that water from the hydrologic cycle must be set aside for the environment to "use" in maintaining the health of its ecosystems, so that it can fill aquifers, rivers, and lakes as it did for millions of years before humans began to tap it. One intended result is the preservation of wetlands and coastal marshes so that they can do their part in cleaning and storing water, and can strengthen the resilience and flexibility of natural ecosystems on which the health of the hydrologic cycle depends.

As an example of the challenges which are faced by society on this issue, the World Economic Forum estimates that a minimum of one-quarter of the flow of the Yellow River in China is needed to maintain the environment; human withdrawals of water currently leave less than 10% in the natural system. Restoring the necessary balance to this system will be complex; it will require reversing centuries of unthinking water use, and finding acceptable alternatives for the people and industries that currently depend upon this water.

Case Study: The Three Gorges Dam

For a long time, building dams has been an effective way to harness water for human use. Recently, however, it has become clear that the consequences of our reliance on dams are mixed. A good example is the controversial Three Gorges Dam on the Yangtze River in China.

Background

For much of the 20th Century, dam projects were seen as cost-effective ways to increase energy availability, harness and provide clean water, and control flooding, while also providing jobs and economic growth. Dams were the preferred way to:

- Manage seasonal variability in rainfall and water supplies;
- Regulate water flows in order to prevent floods;
- Create hydroelectric power;
- Entice vendors and consumers of lake recreation and tourism; and

- Display national pride and know-how in giant infrastructure construction.

Today new dams no longer seem so appealing.

- Most easily diverted major waterways are already dammed, especially in the developed world.
- The human cost of dams in terms of people displaced by construction and resulting pollution is becoming more apparent and less tolerable.
- The environmental costs are becoming evident in terms of destroyed ecosystems and damage to animal and plant species.
- Large reservoirs combined with global warming are leading to high evaporation rates that result in decreased water yields from dams.
- Major accidents from leaky or breached dams have the potential to kill large numbers of people, especially as populations around them become denser.
- Soil erosion along diverted waterways can lead to deadly landslides, while the buildup of silt in other parts of the system impedes water flows and electricity generation.

There are currently 50,000 plus large dams in the world. It is unlikely that many more will be built, since in the 21st Century the logistical, human, and ecological costs would in all probability outweigh the benefits.

The Three Gorges Dam

In no place has the concern over dam projects generated more publicity than in China, home to many of the world's medium and large-sized dams. Included on China's list is the recently completed Three Gorges Dam, the world's largest hydroelectric project. The Three Gorges Dam is part of a concerted effort by the Chinese to tap into the many rivers draining out of the Tibetan high plateau to meet the country's ever growing energy needs.

While initially the Chinese government proudly emphasized the engineering marvel that was represented by the dam, it has become increasingly evident that the dam has taken a staggering social and cultural toll. It is estimated that 1.3 million people were forced into resettlement during construction, with up to 4 million more anticipated to be relocated in the next 15 years due to environmental damage (primarily landslides) and pollution from the project. Entire

Courtesy Wiki user Nowozin.

Three Gorges Dam. Creative Commons Attribution ShareAlike 2.0

communities, ways of life, and ancestral archives have been flooded and/or destroyed. Fears are rising that a natural disaster, such as an earthquake, could cause immense damage to the dam, and potentially kill millions in a resulting flood.

The environmental toll has been no less significant; the litany of effects described above for dams has occurred on an unprecedented scale. Ecosystem destruction and pollution has occurred not only at the site of the dam, but also in communities where large populations have had to relocate and further stress natural balances in regions already suffering from overpopulation. As farmers retreat to higher ground and attempt to build farms on the hillsides, massive erosion and landslides are occurring. Geologists believe that the threat of earthquakes, already a risk in this region, is increased by the pressure from the water in the dam's growing reservoir. Silt accumulation in the reservoir is developing rapidly, and is expected to cause flooding upstream.

The problems created by the Three Gorges Dam have clearly demonstrated that large dam projects are not the solution they were once thought to be. Alternative methods of energy generation more suited to modern life and environmental realities must be developed; these will undoubtedly be more technologically creative, more local, and less environmentally destructive.

See:

http://www.nytimes.com/2007/11/19/world/asia/19dam.html

http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/06/asia_pac_three_gorges_dam/html/1.stm

http://news.bbc.co.uk/2/hi/asia-pacific/4998740.stm#graphic

http://news.bbc.co.uk/2/hi/asia-pacific/7120856.stm

Courtesy www.flickr.com/photos/nite_owl

Waiting for water in West Darfur.
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Water, Politics, and Conflict

Sharing Water

Hydrologic Interdependence -

Hot Spots for Water Tension -

Water as a Vehicle for Peace -

International Waterways and Global Trade

Shipping -

The Impact of Climate Change -

Legal Framework

A US guided missile cruiser travelling through the Strait of Hormuz.

Overview

Given the critical importance of water to individuals, economies, and societies, water stress can lead to significant political and social tensions. Competition for limited water resources can create tensions among different users within a country, as agricultural, industrial, and domestic consumers compete, and rural and urban populations compete. Different political constituencies often vie for water resources, as in the case in the western US, where states compete with one another and with the federal government for control of water.

Sharing gets even more tricky when water sources cross international borders, and countries compete for often scarce resources in a confusing and fragmented legal and regulatory framework. *Water stress often accompanies and can exacerbate other geopolitical tensions*. Many of the world's simmering conflicts are in regions where water is shared and scarce. Some believe that water is likely to be a greater source of conflict in the 21st Century than oil or any other natural resource.

However, history shows that while international conflicts over water often inflame political tensions, *most disputes are resolved peacefully*. Despite the limitations of international law regarding control of water, disputes over international waters tend to induce cooperation rather than incite violence. Still, as water stress increases, conflicts are likely to become harder to resolve. Water security is likely to be of widespread concern among individual nations and the international community as a whole.

Water security is not just a matter of averting hot wars. Global trade depends on peace, and most global trade occurs via international shipping lanes. Countries around the world, individually and collectively, have incentives to keep these global flows moving.

Another area of increasing concern within hydropolitics concerns the case of *environmental refugees* who have been driven off their land by desertification, floods, and other water-related disasters. The international community has yet to develop a framework for protecting the rights of this (as of yet unofficially classified) groups of refugees and displaced persons.

Sharing Water

Hydrologic Interdependence

Consider the following statistics that illustrate the concept of *international hydrological interdependence:*

- According to the World Development Movement, there are currently 263 river basins and countless aquifers that cross the political boundaries of two or more countries.
- These trans-boundary systems cover half the world's surface and cross the territories of 145 countries.

- For example, 19 countries share the Danube River, 13 share the Congo River, 11 share the Nile River, and 9 share the Amazon River.
- One hundred fifty-seven of the world's shared river systems have no formal agreements among host nations for cooperation.

Water stress also impacts domestic politics as populations within a country's borders compete for scarce water resources. This is vividly illustrated in the intense hydropolitics of the western US: farmers and ranchers compete for water with growing urban areas; states are determined to cede as little control as possible to the federal government; growing urban populations and their water needs are forcing growers to turn to less water-intensive crops.

In China, the northern region of the country is home to two-fifths of the nation's population and three-fifths of its crops. This region receives only one-fifth of the country's annual rainfall, however, and competes with the rest of the country for valuable water supplies. Frequent droughts intensify this competition, as do demographic tensions created by the shifting population.

Hot Spots for Water Tension

The lack of water resources to meet the needs of a quickly growing population is a significant factor in the ongoing conflict in *Darfur, Sudan*. Drought and desertification is causing competition among tribes attempting to make a living as either farmers or herders. The conflict has been largely characterized as a racial conflict between Arabs and non-Arabs in the region, but since herders have traditionally been Arab and farmers non-Arab, there is a strong environmental component underlying the conflict. As refugees spill across borders into countries like Chad, suffering from its own water scarcity issues, these underlying tensions are likely to spread.

In fact, *Africa* is home to considerable water stress, much of it crossing political boundaries and fragile states.

- It is the second driest region in the world, after the Middle East.
- Ninety percent of all surface water in Africa is located in trans-boundary river basins which serve 75% of the continent's people.

The Danube River, separating Esztergom, Hungary and Sturovo, Slovakia. Courtesy Ervin Pospisil.

- The Nile River countries of East Africa and the Horn of Africa where water is shared by 11 countries, but largely controlled by Egypt, is of particular concern. This region is home to numerous countries with histories of violent internal conflict and cross-border tension, including Rwanda, the Democratic Republic of Congo, Burundi, Ethiopia, Sudan, and Uganda.
- The rapidly disappearing Lake Chad is often cited as a textbook example of the perils which lie at the intersection of climate change, competition for water, and lack of trans-boundary cooperation.
- Kenya, a previously stable mainstay of the region, is currently experiencing both drought and political tensions; these are often a toxic combination.

The Middle East/North Africa is another area of great concern.

- It is the world's most water-scarce region, with only 1% of the world's renewable freshwater supplies and 5% of the world's population.
- Specific examples of tensions in the region include: disputes among Iraq, Syria, and Turkey over the Tigris and Euphrates Rivers; and disputes among Israel, The Palestinian Territories, Lebanon, Syria, and Jordan over the Jordan River.

Another prominent hot spot lies in *Central and South Asia* where India and Pakistan – long-time rivals, historic enemies, and nuclear powers – share the Indus River System, which also flows through the contested Kashmir region. In 1960 the two countries signed the Indus Waters Treaty to regulate water use. The treaty's provisions have continued to ensure cooperation on water issues between

the two countries, and it has become a symbol of the power of international cooperation over water.

Elsewhere in Asia, other rivals also share valuable headwaters and tributaries of major river systems: China and Tibet (the Yangtze River originates in Tibet and flows into China); as well as North and South Korea (recent tensions ensued as a result of the North releasing waters from the Imjin River, killing South Koreans surprised by the unexpected surge). In addition, the fragile republics of the former Soviet Union share waters in the Caucasus region, and Kazakhstan and Uzbekistan share the Aral Sea, which is rapidly shrinking due to Russian irrigation projects on the two rivers that feed the Sea.

In *North America*, the Rio Grande River separating Mexico and the United States has been the subject of much hydrologic diplomacy. The Rio Grande originates in the mountains of Colorado and flows south, eventually forming the border between Texas and Mexico. It is an important water source to both countries, and has for many years been the focus of treaties and disputes regarding these treaties.

Water as a Vehicle for Peace

There is considerable evidence that managing scarce water resources may actually be a vehicle for broader international cooperation, especially in conflict zones.

- An opinion article in the *New York Times* by Stanley Weiss notes that cooperation over water could lead to cooperation on land issues in the volatile Middle East, quoting Israeli peace negotiator Gilead Sher in saying that water has served as a "catalyst for regional peace" in an area deeply affected by water stress.
- As mentioned above, the successful Indus Waters Treaty between Pakistan and India suggests that rival states can cooperate over the vital issue of water.

International Waterways and Global Trade

Shipping

The shipping of goods via water has always been a mainstay of trade, from the earliest civilizations to today's modern container fleets that roam the world's oceans. *Most global trade goes by ship*, a fact that illustrates the stake most nations have in keeping these waterways open.

- The US military has taken an active role in patrolling many of the world's shipping chokepoints and ports, such as the vital Strait of Hormuz in the Persian Gulf, through which 40% of the world's oil travels daily.
- International maritime law is comprised of a complex set of treaties and agreements that govern the right of sovereign countries to control the water off their coasts.
- Beyond the reach of these laws, the open sea is something altogether different, as the anarchy of modern-day piracy demonstrates.
- Protecting international shipping lanes and cargo ships as they do the business of the world is of critical importance, and countries have long fought over mastery of the oceans (think back to German U-Boats in the Second World War or British and American ships during the American Revolution or the downfall of the infamous Spanish Armada).

The Impact of Climate Change

Climate change is causing waterways in some areas of the globe to dry up. Some goods that used to travel by river no longer can as river beds run dry before they reach the ocean. This impacts not only local populations, but those who trade with them.

In other areas, new waterways are expected to result, leading to new sources of global intrigue in the world of international shipping. Experts note that the melting ice in polar regions will ultimately free up waterways that have been un-navigable to date, perhaps even revolutionizing global maritime travel with new routes. Who will own

and/or control these new routes? Already, countries are scrambling to make claims to valuable underwater real estate.

A final note on water and global trade concerns the fishing industry. Many people in the world depend on fish for protein in their diets; many depend on fishing for their livelihoods. The health of the world's oceans and rivers impacts all aspects of fishing – from extracting fish to aquaculture (fish farming) to the delivery of highly perishable fish to consumers around the world.

Legal Framework

International maritime law is a body of international law which encompasses both international treaties for the governance of matters pertaining to international shipping, and complementary national laws which help to ensure that signatory nations maintain the standards and safeguards to which they have committed in their international treaties. These laws are not intended to fully mitigate tensions among countries, but rather to establish an operational framework and a means of redress for grievances.

The individual bodies responsible for water management are numerous and overlapping, as are their rules, regulations, and enforcement mechanisms. A situation in which local, national, regional, and international governments share responsibility for managing a set of policies is known as *legal pluralism*, and this certainly applies to water laws and policies. In addition to government entities which are parties to numerous treaties, private companies engaged in trade or shipping are parties to legal agreements governing their operations, and interested individuals can be parties to agreements governing local water rights. The entire body of maritime and admiralty law is therefore a complex and unique jurisdictional framework which is becoming a popular specialty in the law as water disputes proliferate.

Despite having so many layers to it, maritime law leaves many questions unanswered. Who is responsible when fossil aquifers are tapped and rivers run dry? What is the recourse for people who are driven from their land due to water scarcity that has multiple and overlapping causes? These and a myriad of similar questions remain to be addressed by national and international legal systems.

Going Forward: Water Stewardship

What We Know: Guiding Principles for Water Stewardship

Knowledge to Action: What You Can Do About the Global Water Crisis

Examples of Citizen Involvement -

PlayPumps International -

Brazilian youths participate in a beach clean-up day as a part of International Surf Day.

Overview

Water stress is likely to be one of the most important challenges of the 21st Century. There is no one "solution." Rather, it will take a unique mix of different types of responses, implemented at a variety of levels, to address this *both intensely local and broadly global problem*. Every locality and country brings to the table its own specific needs, and its own capacities for action. This issue affects us all, and what we do as individuals and as nations can have repercussions far beyond our borders.

Water stewardship depends on actions taken not only by direct stakeholders – those engaged in the extraction, treatment, delivery, consumption, finance, and regulation of water – but also by society more broadly. *Successful stewardship will also require attention to overlapping problems*, such as issues relating to energy, conflict management, education, environment, and food.

The solutions are not only about new technologies. Engineers can only get us part of the way. People must be inspired to think differently about water. Individuals and organizations must be inspired to behave differently in their use of water. This inspiration may come in the form of changes in values and attitudes; it may be in response to price signals; it may be in the form of laws, regulations and enforcement. The most workable solutions will take into account all these factors. And sometimes the solutions themselves will cause new problems.

What We Know: Guiding Principles for Water Stewardship

1) Actions must be taken to address water stress on both sides of the equation: demand and supply.

Demand side responses include:

- *Conservation* – using less water. Technological advances can significantly increase the efficiency of water use by both minimizing waste, and then making the water we do have go further. Getting individuals, farms, and industries to use these technologies usually requires incentives in the form of prices, laws, and community norms in order affect behavioral change.
- *Reallocation* – distributing water differently. This is accomplished using similar tactics as conservation (i.e., technology combined with incentives) with the added task of managing competition.
- *Attention to demographics* – managing population growth, both in terms of overall numbers and location. That the biggest anticipated population growth in this century will take place in water-stressed areas is concerning. Water for 6 billion is proving tricky; water for 9 billion may not be possible.

Supply side responses include:

- *Finding new sources of freshwater* – from technological advances in desalinating ocean water to new ways of harvesting rainwater.

- *Getting more freshwater out of existing stores* – improving equipment and knowledge required to extract renewable water where it exists. Much water scarcity is not due to the lack of water, but is instead due to nonexistent and decaying and/or damaged infrastructure (such as pipes and storage facilities).
- *Addressing climate change to preserve and protect the water cycle that produces freshwater* – attending to the health of the planet and the systems that sustain it.
- *Facilitating virtual water flows* – managing trade policies among countries as well as agricultural policies within countries to encourage transfers of water through tradable goods.

2) The best solutions will incorporate micro and macro responses to water stress.

Like any solution related to human behavior, large-scale change is the result of cumulative personal choices. Individual and household decisions matter a great deal for their own sake (a gallon is a gallon), and for the tipping points to which they contribute. Conserving water in personal hygiene, in cooking, in landscaping will help to alleviate water stress.

The macro or systemic side is no less important. This means attention to governance, finance, technology, investment, trade, and energy policy.

3) Efficiency and equity must be balanced.

Often, the most efficient ways of managing water supplies are not the fairest. Markets may do a good job of making efficient use of natural resources, but *water is not only a natural resource; most also consider it to be a human right*.

- This means figuring out ways to get water to those who need it most, even though it may be expensive and inconvenient.
- This means that when prioritizing the uses of water, all constituencies must be represented.

4) The best solutions will take into account both short-term and long-term water needs.

A 2006 UN Development Program water report notes that current global water use is "analogous to a reckless and unsustainable credit-financed spending spree." Many attempts to augment current water supplies quite literally take water from future generations in terms of

Courtesy Ryan Lackey.

Desalination plant in Ras al-Khaimah, United Arab Emirates.

the environmental damage they inflict. Living within our means requires that we withdraw freshwater at rates commensurate with rates of natural replenishment.

5) Technology can be a double-edged sword.

The application of science and engineering technology to the hydrologic sector has yielded enormous benefits.

- Water treatment practices have saved hundreds of millions of lives over the last century.
- In-home delivery of clean water and sanitation has revolutionized the quality of human life in many parts of the world.
- Crops and irrigation techniques have made it possible to grow food in the desert.
- Information and communication innovations make water management on a large scale possible, in real time.

However, better technology has *also made it easier to use water in unsustainable ways and volumes*.

- Convenience often encourages wasteful practices and water-intensive lifestyles.
- Rural electrification subsidized by states has led to over-drilling and unmonitored drilling.
- Green Revolution technologies have resulted in poor crop per drop ratios. Many crops use massive amounts of freshwater that end up wasted as evaporation or pesticide-polluted run-off.
- Desalination plants disrupt ocean ecosystems, produce environmentally-costly residues, and require massive amounts of energy.

6) It is difficult to balance the needs and demands of all stakeholders.

Consider some of the tensions that must be accommodated in a world of hydrologic stress:

- Urban populations versus rural populations
- Current populations versus future populations
- Upstream versus downstream populations
- Industry versus agriculture
- Small farmers versus commercial agriculture
- Human activity versus environmental preservation
- Business interests versus social interests
- States versus states
- Nations versus nations

7) It is going to take a lot of money to address global water stress.

Just to meet the Millennium Development Goals of safe drinking water and adequate sanitation for all by 2015 is expected to require $10 billion per year.

This money may be in the form of:

- Investments by individuals, hedge funds, tax-payers, and others.
- Aid in the form of cash or special projects, from one nation to another, and from the international community and aid organizations to individual nations and localities.
- Loans, ranging from microfinance to the World Bank and IMF to everything in between.
- Reallocation of existing budgets. The recommended target for national spending on water investment is currently 1% of GDP, but most countries average around half this amount.

The evidence is mounting that *water is a good investment*. The UN estimates that $10 billion per year in investment to achieve the water access targets in MDG # 7 could yield $38 billion per year in economic benefits.

8) Good intentions are not always sufficient.

It is ironic that *many of our most pressing water challenges have been exacerbated, or even created, by attempts to solve other water challenges*. Dams are a great example. Dams have been a hugely successful innovation in managing naturally occurring variability in water flows; they balance out droughts and floods by allowing for the storage and control of natural freshwater. Yet we are increasingly finding that dams can be harmful to the natural environment,

Courtesy Valter Campanato/ABr.

An open sewer in a B razilian favela.

contributing to other stresses in the water cycle and harming fragile ecosystems. Some dams that provide critical water for people along a natural river system deprive others along that same system.

Another example of the irony of good intentions concerns the trade-offs that sometimes exists between water access and water quality. Simply getting adequate and convenient water to people is an important goal. But when that water is dirty, getting it to more people can have tragic results. This illustrates the importance of considering the consequences all along the hydrological spectrum when attempting to address discrete problems.

9) Good water management requires good information. Planning is impossible without accurate data.

Experts agree that *current data on water usage and quality is pretty abysmal.*

- Monitoring can be non-existent or fragmented, from broken water meters to no water meters to unlicensed wells and uncounted pumps.
- Corruption is a factor in many places where data on water quality is compromised or undisclosed.
- Many, many places in the world lack capacity to measure and monitor water supplies.

Moreover, climate change throws a wrench into even the most careful modeling on the most diligently collected numbers. We simply do not know with sufficient accuracy how global warming will affect future water supplies. This lack of information adds enormous risk into any calculations.

10) The news is not all bad.

Any UN or private sector report on water is replete with examples of places where water management is being done

right. It is often noted that Singapore naturally possesses 5% of the water it needs, yet it thrives due to careful planning and the creative importing of water-intensive goods.

If history is any guide, water wars between countries, while frightening to contemplate and certainly a real possibility as water stress increases, are not likely. *Most water conflicts are successfully resolved*. Furthermore, cooperation over this issue could lead to broader cooperation on other contentious issues between neighboring countries.

Knowledge to Action: What You Can Do About the Global Water Crisis

This section brings the information from this edition of the Monitor full circle and seeks to inspire further thinking about how individuals can make a difference with what often seem like complex and insurmountable issues. The global water crisis is a complex problem, but there are many things you can do to start making an impact now.

- *Let your voice be heard*: Advocate for solutions in your community to address the global water crisis such as harvesting rain, starting a community-based water quality monitoring program, and reducing water wasted during farmland irrigation.
- *Calculate your own water use and test your knowledge*: Find out how much water you consume by using the Water Use Calculator (http://www.h2oconserve.org), and measure the water you waste due to leaks by using the WaterWiser Drip Calculator (http://www.acsanet.com/Wwdripca.htm). Test your knowledge with water trivia games from the US Environmental Protection Agency (http://www.epa.gov/safewater/kids).
- *Make a personal commitment*: Pledge to stop drinking bottled water and get your friends and family to pledge as well. Develop a plan to reduce your water footprint by researching facts and actions you can take from the US Environmental Protection Agency.
- *Bring clean water to schools around the world*: Partner with a school in a developing country and raise funds to help complete WASH (Water, Sanitation, and Hygiene in Schools) projects through *H2O for Life*. Participate in *Water for Schools*, a student-led campaign to raise awareness and funds for water projects at schools in developing nations. (See *Getting Involved with Organizations* below for more ideas.) Get your school involved and start helping people in need get access to clean, safe drinking water.

- *Volunteer locally*: Volunteer to clean up a local river, lake, or beach. You can find a local river cleanup day through the National American Rivers Organization. Last year, hundreds of volunteers removed 2,400 tons of trash in 76,000 miles of river during 3,000 river cleanups held across the country. Volunteer to monitor the condition of water bodies near you through organizations including the US Environmental Protection agency.
- *Raise awareness*: Get involved in the next *World Water Day* on March 22, 2010. Sign the petition to adopt Article 31 of the Universal Declaration of Human Rights regarding the right to water. Host a *FLOW: For Love of Water* movie screening party. Hold a *water walk* at your school, church, or office to test how far you can carry a 5 gallon water jug.

For more suggestions of ways that high school and middle school students can help address water issues, as well as how other community members can get involved, see http://www.GlobalWater.org.

Featured Organizations

- **Blue Planet Project**

The Blue Planet Project is an international civil society movement dedicated to maintaining water as a public entity and public right. The Project works with organizations and activists to avoid privatization and protect democratic, community control of water. It is also working on securing an international treaty on the right to water. Maude Barlow, the founder of Blue Planet Project, was recently appointed Senior Advisor on Water to the President of the 63rd session of the United Nations General Assembly. She supports the movement for a UN Covenant on the human right of water.

You can stay informed of news and join the Right to Water campaign through Blue Planet Project's website at http://blueplanetproject.net or http://www.righttowater.ca.

- **PlayPumps International**

PlayPumps International (PPI) is a 501(c)(3) nonprofit organization that has found a unique and affordable way to provide clean drinking water to rural communities in Africa. The organization employs a simple play wheel structure that doubles as a pump that extracts water from underground sources.

Clean water access in communities means that residents and school children do not have to spend their days carrying water from far sources for everyday needs such as cooking. The organization's mission is to enhance public health and offer play equipment to millions across Africa.

To celebrate World Water Day 2007, PPI launched a "100 Pumps in 100 Days" campaign, which exceeded its goals and raised more than $1.5 million to install 111 PlayPumps in sub-Saharan Africa.

You can donate to the *Keep it Flowing* initiative to help PlayPumps International continue their work through their website at http://blog.playpumps.org. You can also become a fan of PPI or join the cause on Facebook, put a banner on your website or social network page, and download an action kit filled with ideas about how your school, club, and/or faith-based group can help support PPI.

PlayPumps International has also launched *Know H20*, an interactive resource website for students and educators to learn more about the global water crisis and their opportunity to create positive change. See http://www.knowh2o.org.

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WORLD SAVVY

MONITOR




Classroom Companion

Classroom Companion

This companion document to the Issue in Focus provides educators with guidance on ways to incorporate the content into classroom teaching. This component is geared toward grades 9-12 teachers, with connections across subjects and disciplines.

Contents of this Classroom Companion include:

- Student Readings and Discussion Questions
- Lesson Ideas and Curriculum
- Additional Resources
- National Standards

Student Readings and Discussion Questions

Below are student readings that provide some insight into global water issues and discuss some of the most relevant topics covered in the Issue in Focus. Each article is aimed at different age groups or reading levels, and is followed by some selected discussion questions.

Advanced:
"Privatization of Water in Bolivia" – An analysis of efforts to privatize water systems in Bolivia (See p. 65)

Intermediate:
"A New Cholera Epidemic" – Overview of the resurgence of cholera, and the recent outbreak in Zimbabwe (See p. 67)

Beginner:
"The Three Gorges Dam" – Article about the building of and the environmental impact of the Three Gorges Dam in China (See p. 69)

Privatization of Water in Bolivia

Bolivia is South America's poorest country and the site of one of the world's most controversial water privatization programs. In the 1990s, under World Bank guidance, the water systems of some of Bolivia's poorest regions were put up for sale to private investors. In the area of Cochabamba, a US-owned company, Bechtel, was awarded a long-term contract to manage and deliver water in that region. The results of this deal shed light on the complexities of water privatization and differences between economic theory and what happens in the real world.

Widespread privatization efforts grew in the late 20th Century with the backing of international finance institutions such as the World Bank and International Monetary Fund. For decades, both institutions have called for the privatization of water services through stipulations in trade agreements and the conditions for loans to developing countries. The intention was to push these countries to make fundamental economic and political changes away from heavy state-control of industries and toward free market systems. Such free market systems were thought to better at producing economic growth, to the benefit all citizens in that country.

In Cochabamba, Bechtel promised to extend water access to many previously unserved communities. For the most part, Bechtel delivered on this promise. But another effect of their involvement was less welcome to local populations: prices for water shot up. The company took over local wells, water pumps, and the public system infrastructure that was already in place, and added to the existing infrastructure to reach new communities. The costs for these improvements and additions were passed on to customers, sometimes doubling the cost many people had previously been paying when water systems were controlled by the government. Many were unable to pay such high rates, and even though water was now available to them, they couldn't access it because they couldn't afford it.

In 2000, riots broke out in Cochabamba as protestors (mainly students, sweatshop employees, and street vendors) became increasingly upset that a private, foreign-owned conglomerate was raising water prices. Hundreds filled the streets in violent protest. The violence shook the confidence of the local government and international investors. Bechtel was forced out, resulting in not only chaos in water delivery in the area, but also in a serious blow to foreign investment in the country.

Although responsibility for managing water in Cochabamba returned to the public utility, Semapa, water privatization initiatives continued in other regions of the country. The water giant, Suez Company, picked up a contract to provide water in the El Alto area of the Bolivian capital, La Paz. Like their fellow countrymen in Cochabamba, residents of El Alto took to the streets in 2005 to protest high water rates, forcing the government to cancel the Suez contract. In the wake of the ouster, tens of thousands of households were left with no water while the local government scrambled to resume water delivery.

The Bolivian revolt has often been called a "consumer rebellion" against the principle of water privatization. In

this instance, protests were largely fueled by high prices and the population's opposition to the anti-democratic nature of private foreign companies controlling their local water systems.

Proponents of water privatization continue to advocate for their cause even while events like the riots in Bolivia take place. They believe that when a government is unable to efficiently manage the treatment, delivery, and finance of water, a private option is necessary and beneficial to consumers.

There is evidence that privatization may work when the cost of water is subsidized for poorer populations. In these cases, special voucher programs are implemented whereby the government or aid organizations subsidize water purchases for citizens unable to afford them.

While the debate over water privatization continues, Bolivia's example reveals the complexity inherent in applying private market solutions to problems in the public realm – a challenge that is only expected to grow as water stress spreads globally.

Vocabulary:

Privatization: the process of converting a government-operated business to one that is privately owned

Stipulation: a restriction that is insisted upon as a condition for an agreement

Conglomerate: a corporation consisting of several companies in different businesses

Subsidize: a grant paid by a government that benefits the public

Discussion Questions:

1. Which international institutions influenced privatization throughout the world in the late 20th Century? Why did these institutions seek to privatize water services?

2. What immediate effects did Bechtel's takeover of the water service have on the people of Cochabamba? What was their reaction?

3. What are the pros and cons of water privatization in developing countries based on this article? Which system do you think Bolivia should follow based on this evidence?

4. Research the effects that privatization has on water conversation. Does privatization have a positive or negative impact on water conservation? Provide examples.

5. Research examples of water privatization in other countries. Compare the situation in Bolivia to another country where the government privatized its water industry. What are the major similarities and differences and which situation was better for its citizens?

6. Do you think water privatization is a better policy than government-run public utilities in developing countries around the world? Which option would you choose and why?

7. What do you think the US should do about NAFTA? Is NAFTA good for Americans? Should it be changed so that its benefits are felt more broadly? If so, what recommendations would you make?

8. Research fair trade. How does this differ from free trade? What are the pros and cons of each system?

A New Cholera Epidemic

Cholera is an intestinal disease caused by ingestion of a parasite found in contaminated water and food. Once a global scourge akin to the plague, cholera has now largely been eliminated in the developed world. With proper sanitation and clean water treatment systems in place, it can be almost completely prevented. Despite this, however, cholera still kills many people around the world today. Many of those affected today are people who have already been hit with misfortune – for instance, those living in poor countries, refugees of war and conflict, and survivors of natural disasters.

In Zimbabwe, for example, the disease has made a giant comeback during the last few years of President Robert Mugabe's rule. An epidemic that began in August 2008 and lasted until July 2009 killed over 4,000 people and infected 98,000. At its peak in February 2009, Zimbabwe's Ministry of Health reported over 8,000 cases per week in what has been labeled Africa's worst cholera epidemic in 15 years. While all of the country's provinces were affected, the highest concentration remained in the urban areas around Harare, where almost one third of all cases were reported.

The Zimbabwe National Water Authority (ZINWA), the country's only water supplier, was unable to prevent the water supply from becoming contaminated. During the crisis, some press reports suggest residents were forced to dig shallow wells to collect water that rapidly became contaminated by the raw sewage on Harare's streets. Thus, cholera spread rapidly without the necessary waste disposal system in place.

After a state of national emergency was declared in December 2008, groups such as the World Health Organization, Doctors Without Borders, UNICEF, and the Red Cross answered Zimbabwe's call for help and stepped in to provide assistance.

Health experts worldwide are very concerned that cholera appears to be on the rise again. The World Health Organization says that rates of infection rose nearly 80% from 2005 to 2006, reaching levels not seen since the 1990s and affecting countries where the disease had been largely eradicated.

These trends are considered shameful to many in the public health and development field because cholera infections can be prevented easily through access to proper sanitation facilities and hand-washing. Cholera's victims are often children who play in dirty water contaminated by fecal matter. They transmit the bacteria through food and water, often infecting entire families and communities in a short amount of time.

The disease kills through severe dehydration caused by watery diarrhea. There is no vaccine and the only cure is to help people rehydrate and isolate them, to prevent others from being contaminated. Simple rehydration therapies, however, are often unavailable because people are too poor or live too far away from health facilities.

Without improving water and sewage systems, the threat of a cholera outbreak remains serious in places like Zimbabwe. Although costly, clean water and sanitation systems must

be developed and maintained to insure against thousands falling fatally ill from this curable disease.

Vocabulary:

Sanitation: the systems for cleaning dirty water and other waste products in order to protect people's health

Epidemic: a widespread outbreak of an infectious disease

Rehydration: the replenishment of bodily fluids, most notably water and electrolytes

Discussion Questions:

1. What groups of people are most affected by cholera today?

2. What causes cholera and why did the conditions in Zimbabwe lead to a widespread outbreak?

3. Why do you think the outbreak was most heavily concentrated around the urban area of Harare?

4. What should the government of Zimbabwe do to prevent another devastating outbreak of cholera?

5. What does this article tell us about the differences in health care worldwide? What steps can you take to raise awareness about this global crisis?

The Three Gorges Dam

People have been building dams since the time of ancient Mesopotamia as a way to control water along rivers and waterways. Dams help stop floods along rivers, collect water for drinking and agriculture, and generate electricity for cities and factories. As technology has improved, dams have gotten larger, allowing them to collect more water and generate more electricity. But is a bigger dam always better?

The Three Gorges Dam in China is the world's largest dam. It is located along the Yangtze River, which flows from the mountains of Tibet out to the sea. The massive dam has broken several world records, such as overall size and largest volume of materials used to build a dam.

China has benefited from the dam. During construction the dam provided jobs to many people; now that it's complete, the dam provides electricity to people throughout the region. In addition, the dam has helped to control flooding on the Yangtze River, which previously caused numerous deaths each year.

However, the dam has also taken a huge social and cultural toll on the region. It is estimated that 1.3 million people were forced to move from their homes during construction of the dam. In addition, officials expect that 4 million more people might have to be moved in the next 15 years because of environmental problems and pollution caused by the dam. When the reservoir of the dam filled up with water ancient buildings and temples were destroyed and people lost the farms and communities they had lived in their entire lives. The Chinese government has promised to help people start new lives and farms, but many people are still waiting for assistance.

The environmental toll has also been large. The levels of pollution around the dam are very high. As farmers move to higher ground and try to build new farms on the hillsides, it is causing erosion and landslides. Geologists believe that there might be even more earthquakes, already a risk in this region, because there is so much pressure from the water in the dam's growing reservoir.

There has never been a dam as large as the Three Gorges Dam, and no one really knows what the long-term impacts will be. But in the short-term, the dam has ruined communities for many Chinese citizens and has caused environmental problems in the region. Many experts are worried that these problems will only get worse. They argue that other countries should learn from the example of the Three Gorges Dam and stop building such large dam projects.

See…

http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/06/asia_pac_three_gorges_dam/html/1.stm

http://news.bbc.co.uk/2/hi/asia-pacific/4998740.stm#graphic

http://news.bbc.co.uk/2/hi/asia-pacific/7120856.stm

http://www.nytimes.com/2007/11/19/world/asia/19dam.html

Vocabulary:

Toll: the extent of loss, damage, suffering, etc., resulting from some action or calamity; for example, the toll was 300 persons dead or missing.

Erosion: the process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.

Reservoir: the area behind the wall of a dam where water is collected and stored

Geologist: a person who studies the origin, history, and structure of the earth

Discussion Questions:

1. What is the Three Gorges Dam and where is it located?

2. What have been the impacts of the Three Gorges Dam, both good and bad?

3. What are some reasons why a country might build a dam? How is a dam used to provide water to citizens?

4. Make a list of other large dams around the world, and compare them to the Three Gorges Dam, in terms of size, volume, area of reservoir, etc.

5. Research more about dams and their environmental impact. Any man-made object like a dam is inevitably going to create changes in the ecosystem around it. Do you believe that the benefits of dams outweigh the costs?

Lesson Ideas and Curriculum

This portion of the guide contains some suggestions for possible lesson plans and activities to teach students about water around the world – across the disciplines. For complete lesson plans and curriculum, see the recommended curriculum units listed at the end of this section.

Social Studies/History

- *Geography* – Map out local fresh water sources such as rivers, lakes, springs, and aquifers. Try to find out where the government in your town or city gets their water. Is it from underground aquifers, local lakes, or piped in from freshwater sources many miles away? Are there any dams in your local area? Map those too, and find out what they do.
- *Borders* – Rivers and other waterways are commonly used to define the physical borders of many countries around the world. Discuss examples of this with students, and why this is so. These waterways don't just form the boundaries of two countries, however; they often form the boundaries of several countries along the waterway. So then who controls the water? What rules/laws apply when one country uses water in a way that impacts another country either up or downstream? Refer back to the "Water, Politics, and Conflict" section of this issue to read about some current trans-boundary issues relating to water.
- *Government and Policy* – Research the US federal clean water acts of the last few decades. What do they stipulate? Who is supposed to carry out this legislation and how? Compare these requirements to your state laws and agencies. Compare your state to another state. Make a chart with three columns and take notes as you compare: 1) federal laws; 2) state laws; and 3) your state. What special conditions do the residents of your state face? If both federal and state governments fail to protect citizens from polluted water supplies, what should people do? Refer to the following set of articles in the *New York Times* online to start your research: http://projects.nytimes.com/toxic-waters.
- *Society and Culture* – The ways in which water is perceived and used differ greatly across cultures. Culture is also influenced strongly by geographic location and access to water. Water is not perceived the same way in Africa as it is in Asia, or in Australia as it is in the Amazon. The role that water plays in shaping the lives of people can be seen in the huge variety of water-related religious practices, spiritual beliefs, myths, legends and management practices throughout the world. What are some different cultural rituals or traditions involving water? If water is such an important element of life and a symbolic part of so many cultures, why is water also so polluted in many places? What might be done to prevent or reverse this pollution?

English/Language Arts

- *Creative Writing* – Have students examine some examples of the use of water in poetry and short stories, such as "Two Ways of Seeing a River" by Mark

Twain, or the poetry of Wendell Berry. How do the authors use vivid descriptions and poetic metaphors to portray the beauty and importance of water? Have students write their own short descriptions or poems illustrating the power and life-giving nature of water.

- *Literary Analysis* – "Water, the fountainhead of civilization as of life, flows through human expression through the ages. Water flows through literature. There is the recurring motif of yearning for rain as the farmer looks at his sun-baked field and his hungry family. There is the intimate relationship of an individual or a community with a particular river or sea. But water in literature is also as a persona larger than a single entity. There is the beneficent life-giver, the nurturing mother-river in stories of fishing villages, and people who live off the sea or river as others live off the forest." (Githa Hariharan) What is the significance of water in the poems or novels you are reading in class? What can this tell us about the significance or value of water to the characters or culture being depicted?
- *Analytical Writing* – Compare the plot of the Milagro Beanfield War to the events that took place in the water privatization protests in Bolivia a decade ago (see the advanced reading above). How were the actions of the lead character and local townspeople in The Milagro Beanfield War similar to those of the villagers in Bolivia? What was the relationship between local landowners and outside companies? What role did the government play in both scenarios?
- *Digital Media* – After researching some of the issues related to water raised in this edition, have students film public service announcements advocating what they think should be done about these issues. Instruct students to choose a specific area – water rights, a focus on sanitation to wipe out cholera, taking a stand on water conservation or plastic bottles, etc. – and have them write a script and film a 60 second PSA to educate other students and urge them to take action. Use the PSAs from the 1H2O website as examples: http://www.1h2o.org/contests/onetake/.

Science

- *Health* – Drinking water: we take it for granted; we need it for basic survival. And yet, what we drink every day is a vehicle for bacteria, chemicals and industrial by-products that are a danger to our health, if not in the short-term, certainly in the long term. Diseases of all kinds can be transmitted through water. Investigate and categorize the kinds of pollutants that can be found in drinking water. What types of diseases do they lead to? What types of technologies are used to treat drinking water so that the water is safer? What pollutants cannot be effectively eradicated from the drinking supply and why?
- *Earth Sciences* – Study the hydrologic cycle. The water cycle is a closed system – all of the water on the earth today existed when the planet was first formed. How much of earth's water is freshwater and usable by humans? How is global warming impacting the amount of freshwater available to humans, and the water cycle overall? What happens when we contaminate or pollute water as it goes through the water cycle, and what does that mean for the future?
- *Ocean Literacy* – In earth science and ecology studies, remember to include a study of the oceans. Even though humans need freshwater, not saltwater, for survival, how do oceans contribute to the health of the earth's ecosystems? What is the role of oceans in the hydrologic cycle? What is the impact of global warming on the earth's oceans and thus on our land and freshwater ecosystems?
- *Physical Science and Engineering* – Learn about dams, or actually build a model dam with students. Learn about how they are built, why certain shapes are used, how they work, the controversies surrounding them, and explore some of the world's largest dams. Check this website for some great teaching resources on dams: http://www.pbs.org/wgbh/buildingbig/dam/index.html.

Mathematics

- *Economics* – Analyze the best ways to manage water from an economic perspective. For example, what is a user tax? What if all water that people drank had a special tax placed on it? What if there was another special user tax for water in plastic bottles? Have students explore this as an option to regulating society's use and sharing of water resources. What are the problems with this kind of solution? What are the benefits for this solution? Who are the people talking about this approach? What are their interests, assumptions and biases?

- *Know the Numbers* – Who uses the most water? To investigate this question, use a combination of thematic maps and raw data to paint a full picture. Make a list of countries and investigate their average use/consumption. Use data from the website of The Pacific Institute: http://www.worldwater.org/www/data.html. What are the implications to these numbers? How does this water usage compare to the amount of water available in each of these countries? For this second question, go to the Worldmapper website: http://www.worldmapper.org/index.html and then search for maps related to "water." Display the "water resources" and "water use" maps and discuss the differences that students see between the maps.
- *Track a Trend* – One of the greatest problems with water use in the world today is that the population has grown exponentially; as the number of people grows, humans are competing for the same water resources, which is causing water stress. Create a chart or graph that shows the trends of population growth in several countries as compared to the freshwater available in those countries. Recommended data websites: http://www.worldwater.org/www/data.html and http://www.prb.org/.

Recommended Curriculum Units:

These lessons and curricula provide an in-depth look at various water-related issues and offer full lessons ready for the classroom.

Population Education
This website has a wealth of lessons and hands-on activities for learning about population and the environment. Several of these lessons focus on water issues and water stress caused by pollution and the growing world population, including "*Water, Water Everywhere*," "*Earth: Apple of our Eye*," and "*Who Polluted the River*" (for elementary students). http://www.populationeducation.org

BioEd Online: The Water Cycle and Global Warming
In this lesson from BioEd Online, students learn about the water cycle and how human activities have influenced the natural distribution system and the overall quality of water, through scientific inquiry. The discussion questions bring up issues around causes and harmful effects of global warming. All written materials are available online while some activities require basic lab equipment. http://www.bioedonline.org//lessons/water-cycle.cfm

Engaging Students Through Global Studies: Every Drop Counts
From Facing the Future, this collection of water-related lessons focuses on the amount of water on earth available for humans and other needy species. This series includes a "water walk" and a personal water-use audit. Materials for this unit and other water-related issues can be ordered online or downloaded for free from the Facing the Future website. http://facingthefuture.org/

Water Partners International: Global Water Supply
These middle and high school curricular units cover a broad scope of subjects including English, science and technology, geography, and economics, all under the umbrella of the global water crisis. Classroom activities range from poetry seminars to vocabulary-building worksheets to science and math lessons about potable water availability. Materials are available at the Water.org website, a wonderful resource around global water-related issues. http://water.org/learn-about-the-water-crisis/lessonplan/

National Geographic Xpeditions: Navigating the Niger
This lesson plan explores the connection between people and the environment in West Africa's Niger River Delta. Students will examine how the ecology of the river is being compromised by overfishing, pollution, dam construction, and increased oil production, and the implications this has both regionally and globally. Visit the Xpeditions website for more water-related lesson plans. http://www.nationalgeographic.com/xpeditions/lessons/14/g68/index.html

Peace Corps Worldwise Schools
This Peace Corps page includes lesson plans, online games, and volunteer stories from around the globe. http://www.peacecorps.gov/wws/educators/enrichment/peacecorpschallenge/

Scholastic: Clean Water Around the World
This site includes teaching resources, online interactive activities, and links to other resources focusing on clean water. http://www.scholastic.com/safewater/

Additional Resources

Books and Readings – Non-Fiction

Bottle Mania: How Water Went on Sale and Why We Bought It
By Elizabeth Royte
With a seamless blend of first-person observation, detailed anecdotes, and hard research, Royte explores the history and ramifications of those ubiquitous plastic and glass bottles. She addresses the economic, ecological, and cultural weight of water as she visits massive New York aqueducts, struggling rural villages in Maine, and high-tech treatment plants in Missouri. Her findings reflect the distressing trend of our heavy footprint on the environment and its resources.

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In *Water Wars*, Vandana Shiva uses her remarkable knowledge of science and society to analyze the historical erosion of communal water rights. Examining the international water trade, damming, mining, and aquafarming, Shiva exposes the destruction of the earth and the disenfranchisement of the world's poor as they are stripped of their rights to a precious common good.

When the Rivers Run Dry: Water – The Defining Crisis of the 21st Century
By Fred Pearce
Pearce presents the alarming ways in which this ecological emergency is affecting population centers, human health, food production, wildlife habitats, and species viability. Having crisscrossed the globe to research the economic, scientific, cultural, and political causes and ramifications of this underpublicized tragedy, Pearce's powerful imagery, analyses, and advocacy make this required reading for environmental proponents and civic leaders everywhere.

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By Robert Glennon
In great detail, Glennon documents water crises in Georgia, California, and even seemingly water-rich Michigan, noting that states generally end up competing with one another over water allocation and that international conflict follows in short order.

Youth and Adult Fiction

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By Herb Shoveller
An inspiring true story that exemplifies the unbreakable bond that united these boys from very different backgrounds and illustrates the true story of friendship and compassion in which a simple wish to help others brings focus to the necessities that unite us all.

The Milagro Beanfield War
By John Nichols
When a Latino farmer flaunts water restriction laws to encourage his small plot to grow, those who hope to develop the land and the other small farmers try to ignore him. However, the two groups eventually must take sides.

Cannery Row
By John Steinbeck
The adventures and misadventures of cannery workers living in the run-down waterfront section of Monterey, California, are recounted and exposed.

The Monkey Wrench Gang
By Edward Abbey
Throughout the American West, dams, bridges, and concrete are destroying the natural environment. A burned-out veteran, a mad doctor, a sexy revolutionary, and a polygamist outdoorsman have joined forces to dismantle the machinery of progress through peaceful means, or otherwise. This book was published for an adult readership and thus contains mature content.

Films

Thirst
Is water part of a shared "commons," a human right for all people? Or is it a commodity to be bought, sold, and traded in a global marketplace? *Thirst* tells the stories of communities in Bolivia, India, and the United States that are asking these fundamental questions. http://www.thirstthemovie.org/

Flow
Irena Salina's award-winning documentary investigation into what experts label the most important political and environmental issue of the 21st Century: the world's water crisis. http://www.flowthefilm.com/

Blue Gold: World Water Wars
Presents numerous worldwide examples of people fighting for their basic right to water, from court cases to violent revolutions to UN conventions to revised constitutions to local protests at grade schools. http://www.bluegold-worldwaterwars.com/

The Water Channel
An excellent resource for short films on various topics related to water. http://www.thewaterchannel.tv/

Food & Water Watch's Water Film Library
Food & Water Watch conducts advocacy and research to protect the quality and safety of food and water. They have a library of films available to borrow, as well as a list of other recommended films. http://www.foodandwaterwatch.org/water/films/library

Websites and Multimedia

Mercy Corps
Mercy Corps' international work fulfills the water needs of vulnerable populations by piping clean drinking water to rural communities, helping to solve resource-based conflicts and delivering water to families during emergencies. Their water topic page includes a wide array of videos and articles that address these global problems. http://www.mercycorps.org/topics/water

Voices of Youth
A UNICEF project that provides an online platform for students and teachers to explore, discuss and partner on issues related to human rights and social change. The Water, Environment, and Sanitation page includes interactive games, fact sheets, brain teasers, quizzes, and other engaging and helpful information. http://www.unicef.org/voy/explore/wes/explore_wes.php

OneWater.org
One Water is a collaborative project at the University of Miami to raise awareness of water issues, and contains a wealth of articles and videos on water concerns around the world. http://www.1h2o.org/

Circle of Blue
An online source for daily global water news and data that has been collected and presented by leading journalists and experts in the field. Circle of Blue spans the subject areas of arts, business, policy, politics, science, and technology, all related to the global water crisis. The site includes insightful articles and engaging video reports that provide detailed analysis of current events related to water. http://www.circleofblue.org/

American Museum of Natural History: Water – H20 = Life

A collection of articles and activities presented by the American Museum of Natural History. This site touches on several aspects of water, including conservation, habitats in water, the economics of water, and regeneration projects. http://www.amnh.org/education/resources/exhibitions/water/edresources.php

H20 For Life

This nonprofit organization run by volunteer teachers, parents, and students connects schools in the United States with schools in developing countries to tackle issues around water, sanitation and hygiene. The project provides students with a model of how to get directly involved in combating global water issues. Additional classroom resources are available on their website. http://www.h2oforlifeschools.org.

National Standards

Activities described in this Classroom Companion correspond to the following national standards from McREL (Mid-Continent Research for Education and Learning).

Social Studies

World History Standards

Era 9: The 20th Century Since 1945: Promises and Paradoxes

- Understands major global trends since World War II

World History Across the Eras

- Understands long-term changes and recurring patterns in world history

World History Topics

- Cultural perspectives
- Farming and agriculture
- Government and the economy
- International diplomacy and relations
- Natural resources
- Population density, distribution, and growth rates
- Population explosion and environmental degradation
- Tension and conflict in the contemporary world
- Trade and trade routes

Historical Understanding

- Understand and know how to analyze chronological relationships and patterns
- Understands the historical perspective

English/Language Arts

Writing

1. Uses the general skills and strategies of the writing process
2. Uses the stylistic and rhetorical aspects of writing
3. Uses grammatical and mechanical conventions in written compositions
4. Gathers and uses information for research purposes

Reading

5. Uses the general skills and strategies of the reading process
7. Uses reading skills and strategies to understand and interpret a variety of informational texts

Science

Earth Sciences

- Understands atmospheric processes and the water cycle
- Understands earth's composition and structure

Life Sciences

- Understands relationships among organisms and their physical environment

Topics

- Earth's surface features
- Environmental Issues
- Conservation of Matter and Energy
- Interdependence of Organisms
- Populations and Ecosystems
- Seasons, weather, and climate
- Water in the earth system

Mathematics

1: Uses a variety of strategies in the problem-solving process

6: Understands and applies basic and advanced concepts of statistics and data analysis

9: Understands the general nature and uses of mathematics

WORLD SAVVY

MONITOR




World Savvy Salon Guide

World Savvy Salon Guide

See the home page of the Monitor website for information on why and how to host a World Savvy Salon – the book club for the 21st Century! See also the Classroom Companion Guide in this edition for original articles and discussion ideas for lifelong learning across all disciplines.

Conversation Starters

1. The debate over privatization of water has grown more heated in recent years as water management becomes increasingly critical and complex. Who manages the water where you live? How much does it cost per unit? How much would you be willing to pay? Discuss the pros and cons of water privatization.

2. Consider the distinction between water as a commodity and water as a human right. Many believe that if the price of water reflected its true value, people would be motivated to use it more efficiently. Others argue that access to clean, safe, and affordable water is a human right. Which argument do you find more compelling and why? Are there other examples of a natural resource that is seen as both a commodity and human right?

3. Given its critical importance to life on earth and increasing tensions between who has water and who doesn't, it has been said that water is the oil of the 21st Century. What are the implications of this statement? Do you agree? Why or why not?

4. Studies have shown that every $1 investment in sanitation results in a benefit of anywhere between five to ten times that amount. Why do you think this is? What are some economic benefits of improved sanitation?

5. The average American consumes 150 gallons/day while people in developing countries have trouble finding even five gallons. The recommended daily water requirement is 13 gallons per day per person. What can individuals do in the context of their own lives – in their homes, workplaces, schools, and communities – to reduce their water footprint? What do you think it will take to get people to reduce their water consumption? How will education, policy change, and new technology play a role?

6. Consider the ways in which water intersects with some of the global issues and countries examined in past editions of the World Savvy Monitor (for example: Sudan, China, Women, Migration, Mexico, Poverty and International Development). Chose one past edition and discuss the importance of water within the context of that issue or country.

Additional Resources

Books and Readings – Non-Fiction

Cadillac Desert: The American West and Its Disappearing Water
By Marc Reisner
This is a history of the American West's water and its great water projects that transplanted water to allow the phenomenal growth of California and the Southwest. The book's perspective of water rights, and ecologic and economic consequences of such actions focuses on government and business tactics.

Bottle Mania: How Water Went on Sale and Why We Bought It
By Elizabeth Royte
With a seamless blend of first-person observation, detailed anecdotes, and hard research, Royte explores the history and ramifications of those ubiquitous plastic and glass bottles. She addresses the economic, ecological, and cultural weight of water as she visits massive New York aqueducts, struggling rural villages in Maine, and high-tech treatment plants in Missouri. Her findings reflect the distressing trend of our heavy footprint on the environment and its resources.

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Films

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Is water part of a shared "commons," i.e., a human right for all people? Or is water a commodity to be bought, sold, and traded in a global marketplace? Thirst tells the stories of communities in Bolivia, India, and the United States that are asking these fundamental questions. http://www.thirstthemovie.org/

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This film presents numerous worldwide examples of people fighting for their basic right to water, from court cases to violent revolutions to UN conventions to revised constitutions to local protests at grade schools.
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The Water Channel
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Food & Water Watch's Water Film Library
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http://www.foodandwaterwatch.org/water/films/library

Websites and Multimedia

Water.org
This US nonprofit organization is committed to providing safe drinking water and sanitation to people in developing countries. The website contains an RSS feed for water news, fact and figures about the global water crisis, and featured water projects. http://water.org/

Circle of Blue
This website is an online source for daily global water news and data that has been collected and presented by leading journalists and experts in the field. Circle of Blue spans the subject areas of arts, business, policy, politics, science, and technology, all related to the global water crisis. The site includes insightful articles and engaging video reports that provide detailed analysis of current events related to water.
http://www.circleofblue.org/

OneWater.org
One Water is a collaborative project at the University of Miami to raise awareness of water issues; it contains a wealth of articles and videos on water concerns around the world.
http://www.1h2o.org/

Mercy Corps
Mercy Corps' international work fulfills the water needs of vulnerable populations by piping clean drinking water to rural communities, helping to solve resource-based conflicts, and delivering water to families during emergencies. Their water topic page includes a wide array of videos and articles that address these global problems.
http://www.mercycorps.org/topics/water