WEEK ONE: WHAT IS WATER? | ESSAY THREE

The Human Impact on Earth's Water Supply

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Human Civilization Centers Upon Water

Fresh water is the universal currency of life. Access to fresh water controls political geography and the economic life of nations. It has shaped the growth and decline of human settlements across millennia and is a potent symbol in many cultures. Where fresh water is not readily available, people have used many technologies to extract it from the ground, harness, and distribute it. The profound connection between Earth's water and human well-being has in turn affected the abundance and quality of this vital resource.

Water Is Life

Villagers in central Rwanda enjoy their first taste of groundwater from a newly installed well. Over 800 million people on Earth do not have access to clean and safe drinking water, mostly in developing nations. ©Charity: Water / Esther Havens

Usage Patterns Vary Across Regions and Nations

One species—humans—currently appropriates more than 50 percent of Earth's accessible fresh water. Seventy percent goes to agriculture, 22 percent is used for industry (mostly to generate hydropower or nuclear power), and 8 percent goes for municipal and domestic use. Notably, these values are global averages; regional patterns vary widely. For example, in the United States more water goes to industry than agriculture, while the reverse is true in Bangladesh. Per capita water use also varies regionally. On average, the United States uses 150 gallons per person per day for domestic and municipal use alone, while the United Kingdom and Ethiopia, respectively, use 31 and 3 gallons per person per day. Global water consumption rose sixfold between 1900 and 1995, due to increases in both human population and per capita use.
What are Some Ways Water is Used?

As you can see almost anywhere you look, humans put water to use in a multitude of ways. We drink it and clean and cook with it. Water irrigates our crops, sustains our livestock, cools our industrial machinery, and flushes away our wastes. People and goods travel across oceans and lakes and down rivers and streams, which also provide places to relax and play and delight our senses.

In-Stream Vs. Off-Stream Water Use

When people use surface water where it is found, it's called in-stream use. The most common such uses are navigation, hydroelectric power generation, and recreation. Off-stream use takes place when people move water from its source. For example, we channel water through pipes to factories and homes, and through ditches to irrigate crops. The water may be fully consumed or returned to its source, perhaps heated, polluted, or otherwise altered.

Most fresh water used by humans around the world goes to irrigation. Vast areas of land are irrigated by delivery systems such as pipelines and canals, some of which may leak over time. Cultivating "thirsty" crops such as cotton, wheat, and rice in dry places also consumes vast amounts of water. These crops are sometimes grown in areas where water supplies are low in general, or where the crops need the most water during the dry season.

How Do Humans Move and Store Water?

We use various technologies—including dams, pipelines, canals, and reservoirs—to control how much water we use and to deliver it to agricultural, industrial, and domestic sectors. Since the ancient Egyptians first diverted the Nile around 4,000 B.C., more than 45,000 large dams have been built around the world. Along with generating approximately 20 percent of the world's electric power, dams divert rivers into water-supply systems, raise water levels for navigation, and control water flow during floods and droughts.

What Happens When We Alter Water Flows?

Our success at putting water to work in so many ways has profoundly affected both the quantity and quality of the world's supply. More than 60 percent of the world's rivers have been dammed or diverted. The feats of engineering that tamed these rivers have transformed the economic prospects of many regions in the world—and also transformed river ecosystems. Dams alter natural habitats by impeding the river's natural flow and changing its flood cycle. Fragmented rivers disrupt fish migrations, blocking access to spawning grounds. Dams trap sediment, and change the temperature and oxygen content of water downstream. (Less oxygen dissolves in the still water behind dams than in moving water.) Upstream reservoirs displace humans and all the other species that live on or near riverbeds, and downstream populations are vulnerable if dams fail. Some scientists think that reservoirs behind dams may contribute to the pressures that can trigger earthquakes.

A watershed is the region or area that drains into a particular lake, river, or ocean. Watershed deforestation and degradation also interfere with natural surface water collection systems. In intact watersheds, plant cover reduces the impact of raindrops and roots hold soil in place, preventing sediment runoff. These benefits are lost when watersheds are deforested, developed, or paved over, all of which reduce the soil's capacity to retain water. Most of the precipitation then runs into the nearest body of water, which can cause flooding. This runoff carries sediment, causing silt (fine particles of sediment) to accumulate downstream.

Enlarge image »

Tapped Out

This illustration shows a cross-section of the aquifer underlying Cape Cod, Massachusetts, where overpumping of municipal wells has led to saltwater intrusion. ©USGS

Human activity is also stressing groundwater resources. Overpumping (extracting water faster than underground systems can recharge) has led to lower water tables not only in the Middle East and northern Africa, but also in parts of China, India, and the United States. Continuous withdrawals can cause water tables to drop, aquifers to collapse, and lands to sink. In coastal areas, it can cause saltwater to intrude into groundwater, destroying valuable storage resources. Since groundwater and surface water systems are linked, a drop in the water table can reduce surface water flow, with consequences for species like the plants along the shores of streams and rivers.
How Does Pollution Affect Water Supplies?

One of the unique properties that makes water so invaluable—its function as a solvent—also renders it vulnerable to pollution from agricultural, industrial, municipal, and domestic uses. Water pollution is a serious threat to freshwater resources worldwide. Currently, 70 percent of India's rivers and lakes are unsafe for drinking or bathing, and 40 percent of the rivers and streams in the U.S. are too polluted for swimming, fishing, or drinking. Some pollutants don't stay on the surface, and can seep down and threaten ancient aquifers. Because groundwater flow is slow and unconstrained, this pollution can take years or even decades to detect and is very difficult to rectify.

What's the Cumulative Effect on Earth's Supply of Fresh Water?

Human consumption has profoundly affected freshwater ecosystems. Ten of the world's major rivers—including the Ganges, the Jordan, the Nile, the Rio Grande, the Yellow River, and the Colorado—now regularly run dry before reaching the sea. Human impact on wetlands, which act as natural water treatment systems, has been particularly severe. Scientists estimate that 50 percent of the world's wetlands may have been lost in the last 100 years. Primarily converted for agriculture, wetlands have also been paved over for urban and suburban development. Both wetlands and rivers may dry up in the face of excessive water withdrawals.

The well-studied Colorado River exemplifies the many human demands on a river system, and the challenges faced by water managers all over the world. You'll explore this complex river system in the accompanying Case Study: "How the West Was Watered."

The water cycle connects all of Earth's systems. As we will see, the main challenge is not that the planet has too little fresh water, but that humans fail to value and manage the resource so that all species can depend upon a safe and adequate supply.

Related Links

NGM: Water Pressure »

Article about the challenges of providing clean, fresh water to all of humanity.

FAO: United Nations Water »

An educational portal devoted to the importance of the world's water resources and host of the annual "World Water Day."

NASA: The Water Cycle »

Article explaining the important role water plays on Earth as we follow it along its journey through our atmosphere.

EPA: Water For Kids! »

Resource list for educators and students with projects, art, and experiments about environmental protection.