The Case for Conserving Water

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Humanity faces a crisis with respect to fresh water

Humans require water for many tasks in the modern lifestyle and our demands on fresh water systems have created a pressing crisis for humanity. It's hard for Americans to imagine living with water shortages, but the reality is that about 700 million people today lack reliable access to safe drinking water and one-third of the global population lives in regions with moderate to high levels of stress on local water supplies. The prognosis for future water supplies in some nations is even bleaker. Today, 31 nations are experiencing water stress (defined as < 1500 m^3 of fresh water per capita per year) or water scarcity (< 1000 m^3 of fresh water per capita per year). That number is expected to grow to 48 nations by 2025. To make matters worse, much of the stress on water supplies will occur in regions with rapid population growth. For example, by 2025, it is predicted that half of all Africans will live in nations with water stress or scarcity.

For these reasons, stresses on water supplies are rated by scientists as one of the biggest environmental challenges facing humanity in the 21st Century. The fact at the center of the issue is that, on a global level, water supplies are becoming increasingly stressed because fresh water withdrawals have risen 2–3% per year since 1940, while the annually-renewable runoff has essentially remained the same. Some nations, such as Egypt and Pakistan, are already nearing 100% withdrawal of their fresh water supplies, but will need much more water in coming decades due to rapidly-increasing populations.

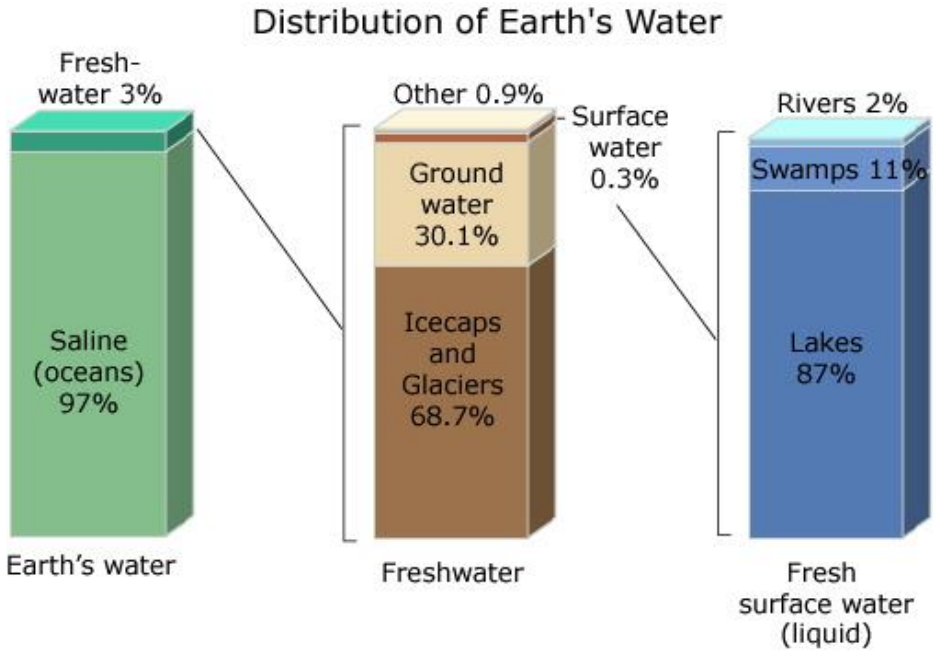
This critical situation is the result of three facts:

- Most of Earth's water is unusable by humans
- The human population increases over time while water supplies stay roughly constant
- The fresh water we can easily obtain is not equally distributed with human populations.

Let's look at each of these facts in greater detail.

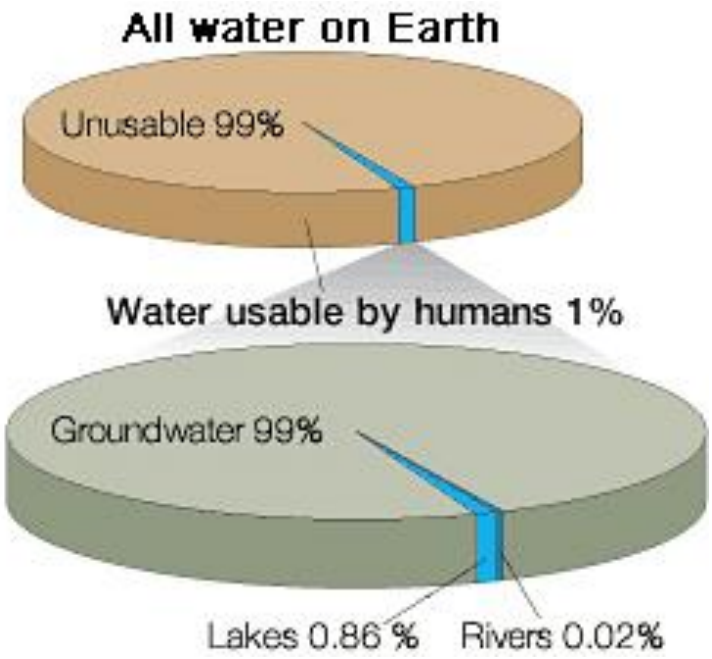
Most of Earth's water is not directly usable by humans

The water cycle contains numerous reservoirs of water in the soil, on the surface, and in the air. As shown in the **Figure** below, 97% of Earth's water is saline or "salt" water and the remaining 3% is "fresh" water. Salt water contains about 35,000 milligrams of dissolved salts per liter of water as opposed to fresh water which typically contains about 100–150 milligrams of dissolved salts per liter of water. When cells of terrestrial plants are bathed in salt water, water from inside the cell is drawn to the surrounding salt water by diffusion (because the concentration of water is higher inside the cell than outside the cell) and the cell shrivels and dies. Hence, we cannot directly use saline water for drinking or irrigating our crops and must rely on the planet's very limited supplies of fresh water from rivers, lakes, and groundwater.



Caption: Only about 3% of Earth's water is fresh water, and only 0.3% of this fresh water is located in surface waters such as rivers and lakes.
Source: https://water.usgs.gov/edu/watercyclefreshstorage.html

While approximately 3% of Earth's water is fresh water, sizable amounts of fresh water is not easily accessible to humans because it is frozen in icecaps and glaciers, or located deep underground. If we eliminate those sources, we see that only about 1% of the planet's water is fresh water that we can easily access (**Figure** below). If we break down this 1% of readily-available fresh water, we see that less than 1% of this water (that's < 1% of 1% of Earth's water) is located in the freshwater lakes and rivers on which humans rely so heavily to meet our water demands – the rest being located in shallow groundwater aquifers.

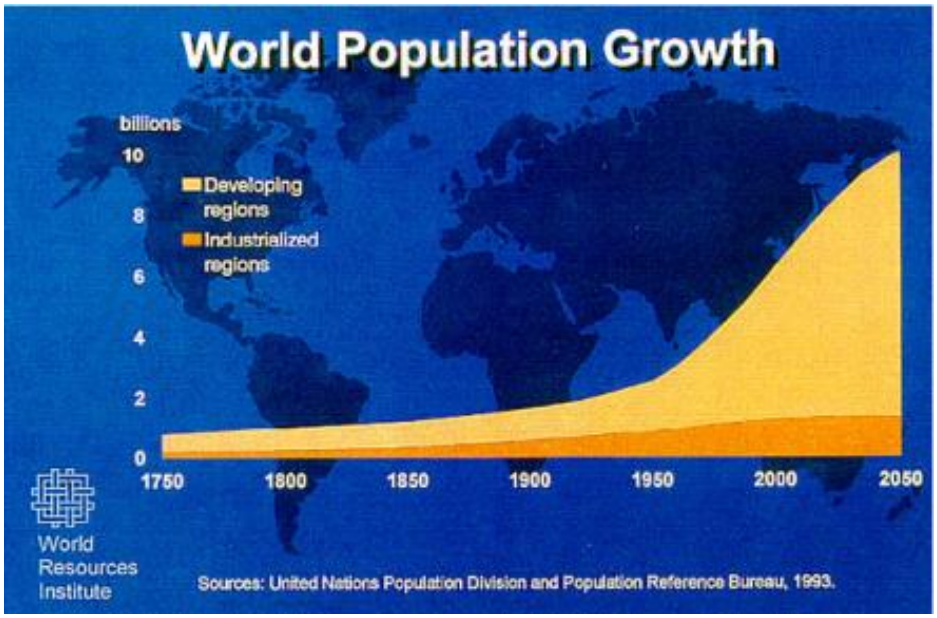


Caption: Our fresh water rivers and lakes only contain about 0.1% of Earth's total water, a resource we need to share with aquatic habitats and wildlife to maintain healthy ecosystems.
Source: https://www.slideshare.net/britgirl2/the-water-cycle-power

These numbers are often hard to grasp, so let's frame things with more familiar measurements. If a one gallon (3.8-liter) bottle were to hold all of the water on Earth, the amount of fresh water would be about 3% of this, which is about half a cup (or a little more than one liter). The quantity of readily accessible fresh water would be 0.01% of the bottle, or a mere 38 ml—less than 8 teaspoons. That's not much to share with nearly 7 billion humans and all of the other organisms on our world that require fresh water, showing the pressing need for water conservation efforts.

The human population continues to increase and water supplies do not

While the rate of human population growth has slowed in recent decades, the human population continues to increase as births outnumber deaths on an annual basis. The human population is approaching 7 billion, and we are still mired in a period of rapid exponential growth that saw human populations on our planet explode in the late 19th and 20th Centuries (**Figure**).

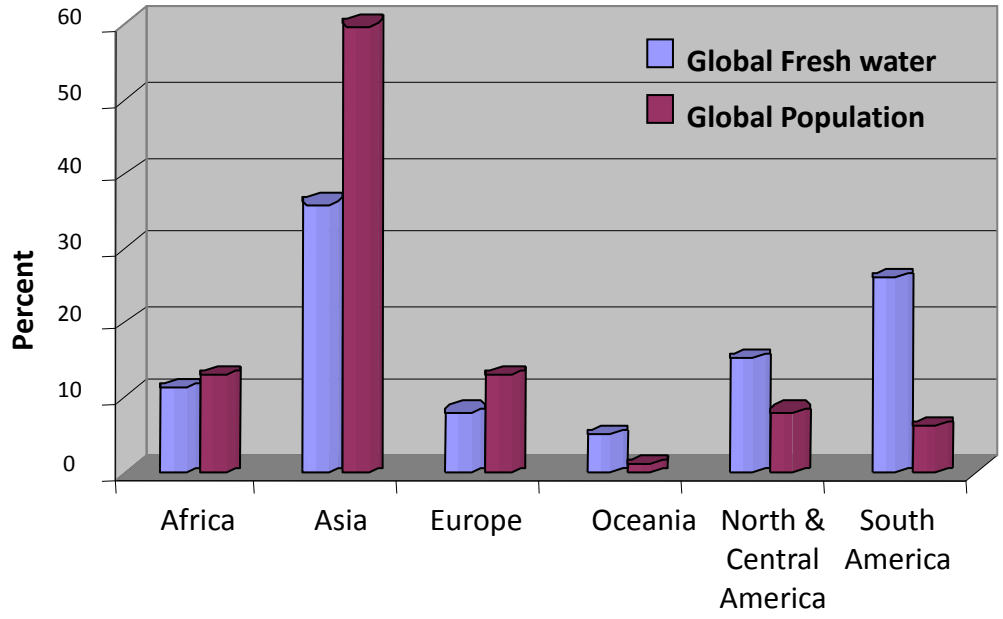


Caption: It took the human population hundreds of thousands of years to reach a population of one billion in the early 1800s, and an additional 5 billion people have been added to the global population in the 200 years since then.
Source: http://brilliantgem.blogspot.com/2007/05/world-population-growth.html

The water crisis is exacerbated by this growing human population, for while the number of humans that require water increases, the amount of fresh water available on Earth remains essentially the same. This means that every day, each human's personal "share" of the planet's water supplies decreases and humans must take increasingly higher amounts of water from rivers, lakes, and groundwater. These withdrawals, coupled with modifications like dams that increase water supplies, impair the functioning of aquatic ecosystems and impact wildlife and water quality. As long as the human population continues its current upward trajectory, the per-capita share of water will decrease for each of us and our impacts on aquatic systems will escalate – not at all an enviable trajectory.

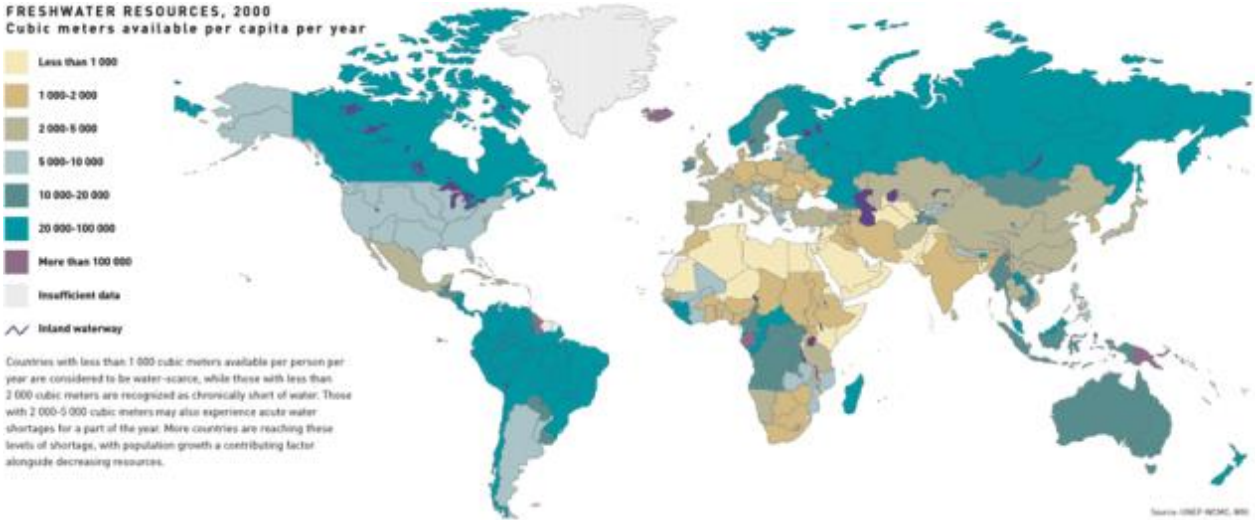
Water supplies and the human population are not equally distributed

Humanity obtains nearly all of its water from rivers, lakes, and groundwater that are fed by the 20% of global precipitation that falls on land. This **annually renewable runoff** is the amount of fresh water that is replenished each year. Since precipitation levels differ around the globe, so does the amount of annually renewable runoff – some regions have abundant supplies of fresh water while others have very little. A comparison of available fresh water and human population shows that Asia is the most "water poor" region, with nearly 60% of the global population but only 36% of global fresh water (**Figure**). Conversely, the Americas and Oceania are "water rich," with much higher proportions of water to population.



Caption: Comparisons of the percent of global water supplies and percent of the human population in world regions shows the relative stress on water resources around the world.
Source: http://www.un.org/waterforlifedecade/

When we overlay population and fresh water resources, we see sizable variation in the per-capita water supplies in nations (**Figure**). Where populations are large and water supplies are limited, such as in the Persian Gulf region and North Africa, the amount of water available per person is small. In nations with small populations and/or lots of fresh water, such as Canada, per-capita water supplies are high.



Caption: Water supplies and population are not equally distributed on Earth, and many of the fastest-increasing regions (such as the Middle East/North Africa and south Asia) with respect to human population are those that are already stressed for water supplies.
Source: http://atlas.aaas.org/index.php?part=2&sec=natres&sub=water

This unequal distribution of population and water supplies, coupled with inefficient use of water resources and poor infrastructure, has created a situation where competition for fresh water is rivers, lakes, and groundwater can be intense.

Water shortages may slow economic growth and lead to armed conflict

The current and looming problems with meeting humanity's demands for fresh water have profound consequences. First, some economists fear that limited water supplies may prove to be a major impediment to economic growth in some developing nations and slow or stop their economy's industrialization. Given the interconnected nature of the global marketplace, the lower levels of economic activity in those nations would likely translates to slower economic growth in other nations, cascading the economic impacts around the world.

Second, there are fears that military conflicts may arise over rivers that span international boundaries in regions with high water demands. Excessive water withdrawals or the construction of dams that reduce river flow could force "downstream" nations into armed conflict with "upstream" nations if their water supplies are curtailed. The Nile River in Africa, Jordan River in the Middle East, and the Tigris and Euphrates rivers in western Asia are examples of waterways where such conflict could erupt (**Figure**). Conflicts over water supplies are occurring with the United States as well. The states of Georgia, Florida, and Alabama are currently embroiled in a dispute over water withdrawals from two shared river basins. Conflicts for water from rivers in the arid western United States, such as the Colorado River, have similarly been raging for over a century.

Caption: The Nile River, which originates in the highlands of East Africa and flows northward to the Mediterranean Sea, may be a site of armed conflict over fresh water supplies if Egypt, with its sizable and modern military, objects to water withdrawals or dam projects by upstream nations.
Source: https://www.internationalwaterlaw.org/blog/2014/06/02/dr-salman-m-a-salman-entry-into-force-of-the-un-watercourses-convention-where-are-the-nile-basin-countries/

There is, however, reason for optimism

While the growing human population poses problems for a sustainable water future, there is some good news. We have before us an opportunity to move towards greater sustainability in water supplies through one simple approach – finding ways to use water more efficiently. Because our current uses of water are far more inefficient than they could be, we have tremendous potential to make our existing water supplies go further than they do now, thereby lessening strains on the aquatic systems that support us.