MISSISSIPPI STATE UNIVERSITY EXTENSION

Water: Availability and Use

"When the well's dry, we know the worth of water." – Benjamin Franklin

A Global View of Water

With 70 percent of the earth's surface covered in water, how could we ever run out? Despite all this water, the majority of it is not immediately accessible to or usable by humans. In fact, only 0.5 percent of the total water on Earth is readily available for human use. This water is in aquifers, lakes, reservoirs, rivers, streams, and rainfall. As for the rest of the planet's water, 97 percent is saltwater, which can be made accessible after desalination, and the remaining 2.5 percent is freshwater that is frozen as polar ice or stored as groundwater.

High demand for and continued misuse of water resources has increased widespread risks of water stress. Water stress occurs when the demand for water exceeds the available amount. This stress often occurs during a certain period of time or when water quality is poor, limiting safe water use. Rationing the small percentage of water that is available to the growing human population will be increasingly difficult. One major challenge in meeting water demand is the uneven distribution of available water in relation to inhabited geographic areas.

About 60 percent of the available freshwater is found in just nine countries—Brazil, Canada, China, Columbia, the Democratic Republic of Congo, India, Indonesia, Russia, and the U.S. These nine countries represent about 44 percent of the earth's landmass and are home to 35 percent of the global population. Even within these countries, the distribution of water is uneven.

Many countries are already under water stress, whether physical or economic. Physical water stress is when water supplies cannot meet demands because they are being diminished at a rate that causes water scarcity. Economic water stress occurs when water supplies do not meet demands because of a lack or failure of infrastructure or technology. In many regions, economic water stress is caused by inability to sanitize contaminated water. Without improved sanitation technology and water management approaches to lessen economic and physical water stress, populations around the globe could face severe water shortages. If water consumption patterns remain consistent and steps are not taken to mitigate impaired water resources, projections estimate that nearly half (3.5 billion) of the global population will live in water-stressed river basins by 2025.

Water Scarcity and Use in the U.S.

The U.S. is vulnerable to water stress. Regions within the U.S. are already stressed by the discrepancy between the rate of groundwater recharge and the increasing pressure placed on aquifers. The level of water stress in a region is determined by how much the water demand exceeds the available supply (in other words, how unsustainable the water use is). However, factors contributing to water stress are extremely complex.

For example, the southwestern states are characterized by low precipitation, high evaporation, and frequent drought. In addition, this region is experiencing rapid population growth, which will only increase demand on water supplies. Shifts in climate patterns also influence water stress because precipitation and, subsequently, stream flow and snowpack are expected to have higher variability or altered flow patterns. This variability and alteration of flow spells out uncertainty in terms of reliable water availability because areas may receive more or less precipitation than in previous years. Shortages in water have led to increasing conflicts over water supplies.

Legal aspects of water use designations are also an obstacle, as most of the western states function under an appropriation doctrine that has two basic principles: 1) the first to settle a stream has the first right to use it and 2) water use must be beneficial and not wasteful. However, these laws don't clearly outline how much water is lawfully designated to certain uses (for example, environmental, energy, agricultural, or human consumption). These complexities are further compounded when considering additional social and economic factors, such as cultural or religious water rights and distribution of water use via exported goods.

Demand for and use of water in the U.S. comes from a number of different sectors. The latest report (2015) found that 87 percent of water use came from freshwater sources, and the remaining 13 percent came from saline or brackish coastal water for thermoelectric power. Thermoelectric power, irrigation, and public supply accounted for 90 percent of freshwater withdrawals (**Figure 1**). Water withdrawals and consumption for irrigation increased 2 percent from 2010; however, irrigation withdrawals were approximately equal to those in the 1960s. Public supply withdrawals decreased 7 percent in 2015 despite a population increase of 4 percent (12 million people), reflecting declines in per capita use.

Supplies of surface and ground water have been declining in much of the U.S., and many aquifers are being drawn down faster than they are being recharged. Across the nation, fresh groundwater withdrawals for irrigation account for 70 percent of total fresh groundwater withdrawals. That groundwater use is not dispersed evenly across states; in fact, 46 percent of groundwater withdrawals for irrigation came primarily from Arkansas, California, Nebraska, Idaho, and Texas. More than 50 percent of total withdrawals in the country were accounted for by 12 states.

Water scarcity can lead to societal instability and legal battles over use rights. Mississippi's neighbors are in a legal battle over water that has been going on for over two decades. In this tri-state disagreement between Georgia, Alabama, and Florida, Georgia is trying to secure water from the Chattahoochee River for the growing Atlanta metro area, while downstream Alabama wants to secure water for power generation, fisheries, and other uses, and Florida needs water for its multi-million-dollar shellfish industry in the Apalachicola Bay. This legal battle has not been resolved and it begs the question: Which water needs should be met first? Understanding how we use water in Mississippi is an important step in identifying where we can improve water use efficiencies and meet multiple user needs.

Water Use in Mississippi

Of the 322,000 millions of gallons per day (mgd) withdrawn across the nation, Mississippians use an average of 2,690 mgd, or 0.83 percent. The majority of water use is for irrigation, public supplies, and self-supplied industrial (**Figure 2**). This isn't surprising as manufacturing and agriculture are two of the state's largest economic industries.

Mississippi's Delta region (northwestern area of the state in the Mississippi River floodplain) is under intense agricultural pressure, resulting in heavy use of water resources for irrigation. Irrigation accounts for 98 percent of water use from the Mississippi alluvial aquifer in the Delta region. With the global population projected to grow by 2–3

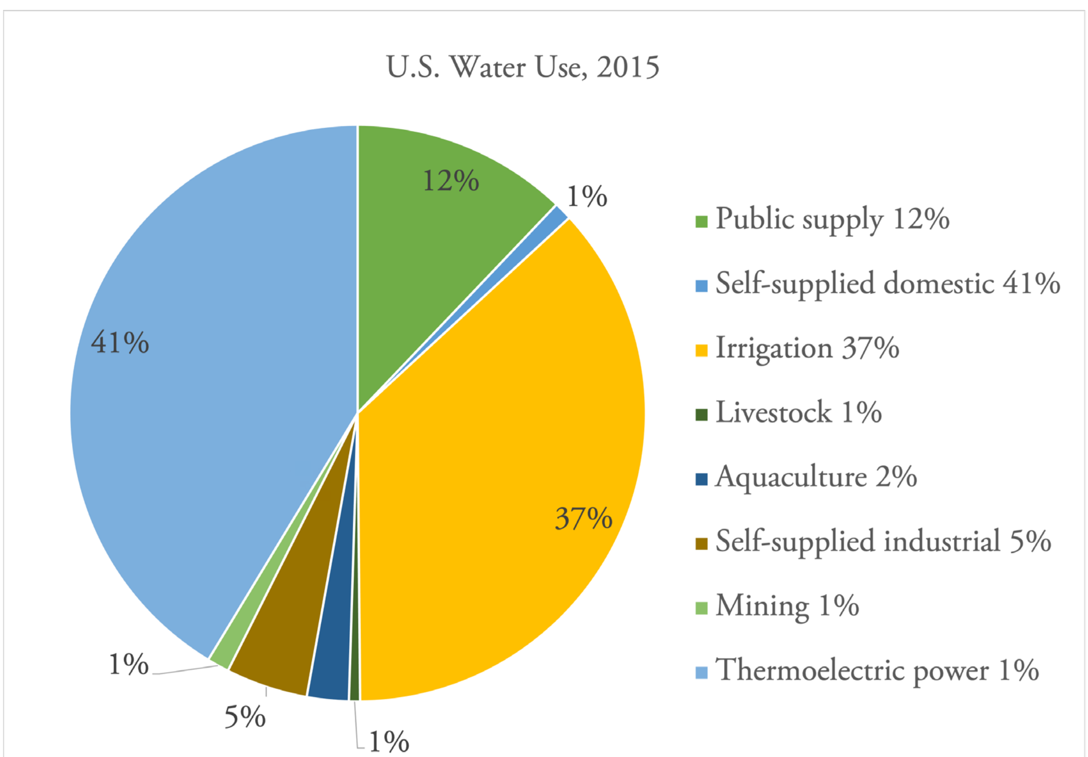

Figure 1. U.S. water use in 2015. Created based on data reported in USGS circular 1441.

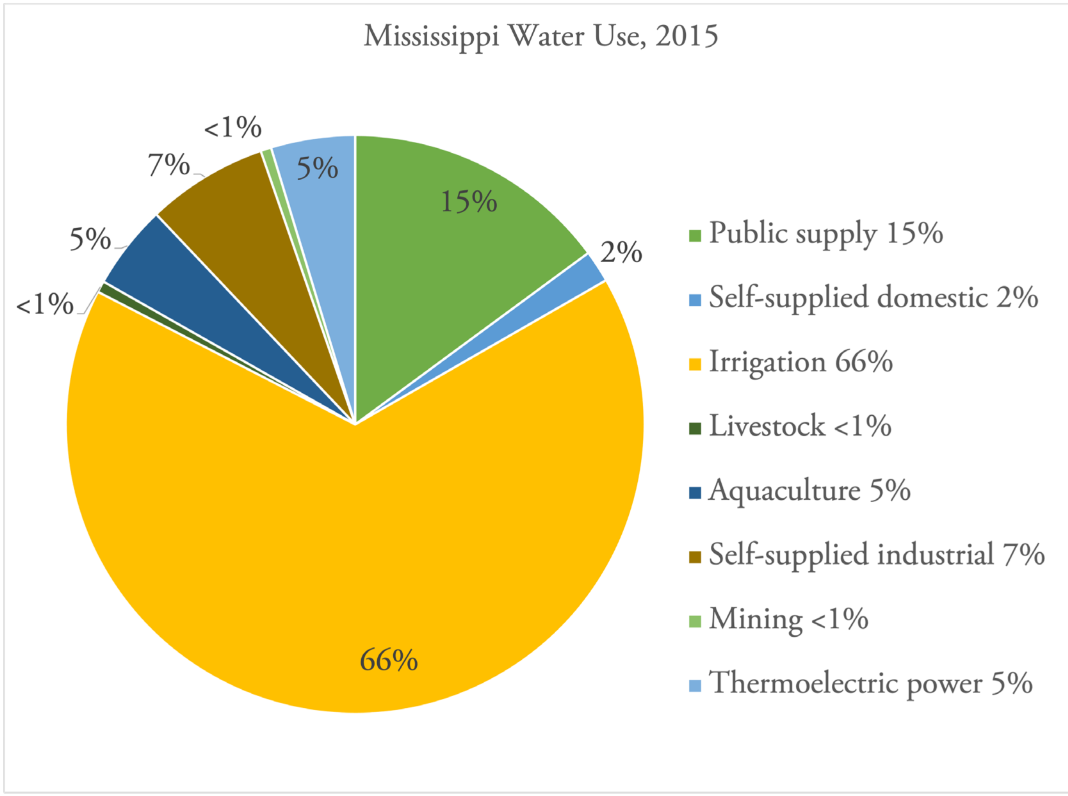

Figure 2. Mississippi water use in 2015. Created based on data in USGS circular 1441.

billion people over the next 40 years, the demand for water to produce food and fiber and for domestic use is only going to increase. Through water conservation efforts and moving toward innovative and efficient water use designs, we can protect our water resources and make our agricultural production more efficient and sustainable.

Narrowing the gap between supply and demand for water will require changes in consumer behavior, responsible management, and advances in science and technology. Since 2005, declines in water use in certain sectors highlight the success of water use efficiency innovations. Technologies for discovering new sources and improving methods of cleaning or recycling water will continue to be of great importance moving forward.

Direct and Indirect Water Use

Advances in water technology and management for water use efficiency and conservation should focus on individual use, as well. Every day, Americans use water in various ways, both directly and indirectly. Direct water use includes water used for bathing, cooking, and drinking. Indirect water use refers to the water used to make products that we consume ("virtual water"). This includes water used to produce steel for cars, fiber for clothing, or parts for the many tech devices we use. **Figure 3** illustrates water use per capita in the U.S.

Individuals can make conscious efforts to reduce water usage and, in doing so, contribute to larger water conservation goals. At home, this can come in the form of (direct) use reduction practices (reducing shower time) and efficiency management (watering gardens at optimal times during the day and with rainwater recovery systems; upgrading or improving appliances; and installing low-flush toilets). Indirectly, making smart consumer choices can have a large impact on the virtual water we use. Buying local products and products that were made sustainably and using fewer manufactured products are easy ways to lessen your indirect water use.

In the community, individuals should become aware of local water issues, policies, and conservation groups. Becoming involved in the management of water within your community raises awareness of water's importance. Ultimately, efforts big and small result in higher quality and quantity of water resources.

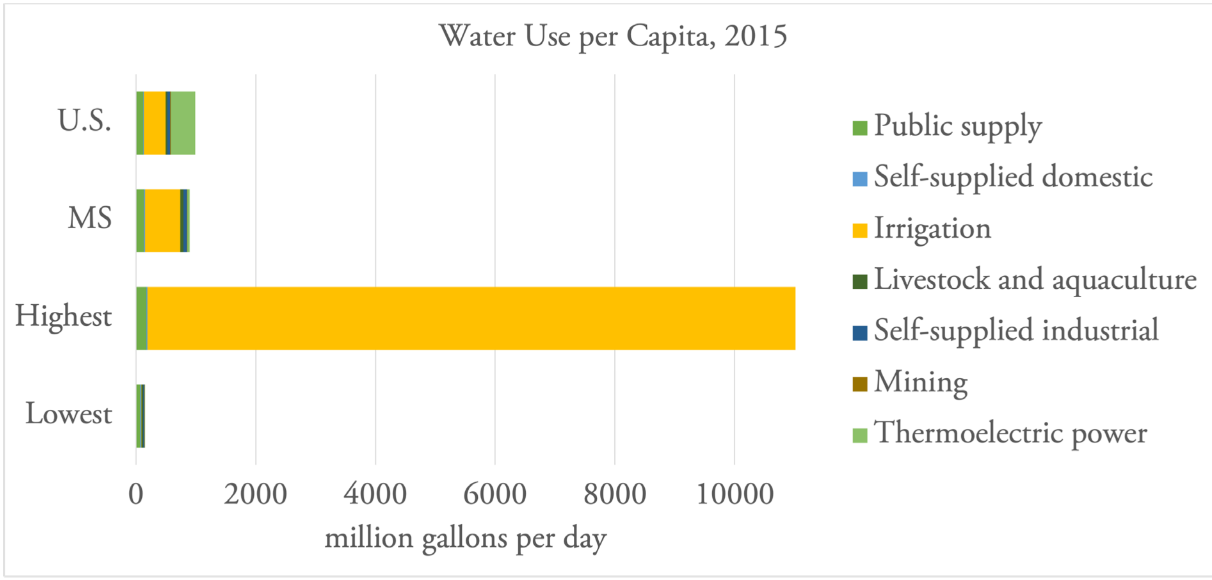

Figure 3. Direct and indirect water use per capita. Created based on data in USGS circular 1441.

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By **Beth Baker**, PhD, Associate Extension Professor, Caleb Aldridge, former Research Associate, Austin Omer, former Extension Associate, and **Mark Hill**, Research Technician, Wildlife, Fisheries, and Aquaculture.

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