Agricultural Water Use

This EnviroAtlas national map estimates the total gallons of water in millions of gallons per day used for agricultural irrigation in each 12-digit hydrologic unit (HUC) in the contiguous United States. Estimates include self-supplied surface and groundwater, as well as water supplied by irrigation water providers, which may include governments, corporations, or other organizations.

Why is agricultural water use important?

According to United States Geological Survey (USGS) water use data, agricultural irrigation accounts for approximately one-third of all water withdrawn in the U.S. on a daily basis. As a major water consumer, agriculture practices play a significant role in the availability and cleanliness of a region's water supply for the ecosystems, towns, and individuals that depend on it. Evaluating the demand for water resources can provide insight into the delicate balance between water availability and use.

Agricultural irrigation includes water used before, during, and after growing seasons to suppress dust, prepare fields, apply chemicals, control weeds, remove salt from root zones, and protect crops from frost and heat, as well as other activities needed for harvesting. The water use for agricultural practices varies throughout the year and depends on many factors, such as weather patterns, other land uses within a watershed, crop type, evolving technologies and practices, and cost. The variability of agricultural water use may continue as weather and climate patterns shift, thus changing water availability and demand in some areas.

Production of the national food supply represents one critical use for water in the U.S. However, agriculture is not the only important water consumer within a watershed. Individuals and communities depend on water resources for drinking, household use, recreation, industry, power generation, and transportation, among other uses. Plants and animals also depend on a clean and plentiful water supply. Though water appears to be everywhere, it is a finite resource. Overuse within a watershed can lead to unintended consequences, such as water shortages, the need for additional treatment, and higher costs from storage and distribution. Maintaining appropriate natural resource usage can help ensure the availability of a stable water supply.

In addition to the economic impacts of treating or delivering water, the overuse of water resources can impact ecosystems,


Photo: Eric Vance, EPA

such as forests and wetlands, and the ecosystem services, or natural benefits that they provide. Natural ecosystems such as wetlands, trees and forests, and water bodies help protect the supply and quality of water resources. By storing and filtering rainwater, regulating the speed and volume of water flows, and preventing sediment and contaminants from entering the waterway, natural resources ensure that clean and plentiful water is available for drinking, recreation, and aquatic habitat. Understanding the demand placed on these ecosystems will help ensure their continued ability to provide such services.

How can I use this information?

The map, Agricultural Water Use, can be used to help evaluate the demand for clean and plentiful water within a 12-digit HUC. Understanding water uses is a critical step to identifying potential imbalances and trends in supply and demand. Within EnviroAtlas, this map can be used in combination with maps on domestic water use and industrial water use to visualize which watersheds have relatively high demands placed on their water resources.

These data can also be used in conjunction with the maps and data that illustrate water availability within 12-digit HUCs. Together, these data suggest where demand for water may outpace availability at the watershed scale. It also highlights where the ecosystems that protect water resources may experience strain, require protection, or benefit from restoration. In areas with significant imbalances or detrimental trends, additional research may help to understand and alleviate pressure on the water supply.

CONTINUED ON BACK ▶

How were the data for this map created?

This map was created using USGS 2005 Water Use data to estimate the daily agricultural irrigation per acre for each county in the contiguous U.S. Where possible, irrigation for golf courses was excluded from the calculation. Some county results with zero reported use per acre may in fact have irrigated land. To ensure capture of this other irrigated land, counties with zero reported use per acre were assigned the generalized state-level median or mean, whichever was closest to the state-level majority.

To distribute withdrawals for agricultural irrigation within the county, the final irrigation assignments were then converted and applied to more specific 30-meter locations using remotely-sensed data on irrigation[1], land cover, and crop type. Irrigated locations were identified by applying algorithms, along with climate and agricultural data, to satellite imagery. The potentially irrigated crop locations were further refined by crop type using the 2010 USDA Cropland Data Layer (CDL) and the 2006 MRLC National Land Cover Data. Finally, the applied water use values were summarized by 12-digit HUC.

What are the limitations of these data?

The data that are reported for water usage in the United States have limitations. With regard to remotely sensed estimates, vacillating weather patterns influence the irrigation demand from year to year. Irrigation in naturally wetter regions is more difficult to differentiate.

With regard to USGS estimates, irrigation water use estimates also cover a variety of uses in addition to agriculture, such as for golf courses, parks, nurseries, turf farms, and cemeteries. Where estimates were available, golf course irrigation was excluded. Another complication in estimating water use is the inherent nature of water withdrawals and delivery. Irrigation water withdrawals are calculated in the county in which they occur; however, this water may cross county, even multiple, boundaries before it is applied. Considerable efforts have been made to report the most accurate estimates across these data.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The USGS water use data is available to download from the USGS water use website. Irrigated Lands from Remote Sensing data can be downloaded from the Sustainability and the Global Environment (SAGE) website.

Where can I get more information?

There are numerous resources on agricultural water use and demand; a small selection of these resources is below. EPA and USGS have additional resources on their respective websites. For information on how the data was created or its limitations, see the metadata. For specific questions about the USGS Water Use data, please visit the USGS website or the USGS Guidelines below. For the original Irrigated Lands from Remote Sensing, please refer to the University of Wisconsin SAGE website or Ozdogan (2008). For additional information on how the data were created, access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about this map contact the EnviroAtlas Team.

Acknowledgments

EnviroAtlas is a collaborative effort by EPA, its contractors, and project partners. Megan Mehaffey and Anne Neale, EPA, and Elena Horvath, EPA Student Services Contractor, developed this map for EnviroAtlas. This fact sheet was created by Elena Horvath and Jessica Jahre, EPA Student Services Contractors.

Selected Publications

1. Ozdogan, M., and G. Gutman. 2008. A new methodology to map irrigated areas using multi-temporal MODIS and ancillary data: An application example in the continental US. *Remote Sensing of Environment* 112: 3520–3537.

Gibbison, G., and J. Randall. 2006. The salt water intrusion problem and water conservation practices in southeast Georgia, USA. *Water and Environment* 20(4):271–281.

Hutson, S. (compiler). 2007. Guidelines for preparation of state water-use estimates for 2005. U.S. Geological Survey Techniques and Methods Book 4, Chapter E1. U.S. Geological Survey, Reston, Virginia.

Joyce, B.A., V.K. Mehta, D.R. Purkey, L.L. Dale, and M. Hanemann. 2011. Modifying agricultural water management to adapt to climate change in California's central valley. *Climatic Change* 109(1): 299–316.

Kenny, J.F., N.L. Barber, S.S. Hutson, K.S. Linsey, J.K. Lovelace, and M.A. Maupin. 2009. Estimated use of water in the United States in 2005. U.S. Geological Survey Circular 1344, U.S. Geological Survey, Reston, Virginia. 52 p.

Mayer, A., and A. Muñoz-Hernandez. 2009. Integrated water resources optimization models: An assessment of a multidisciplinary tool for sustainable water resources management strategies. *Geography Compass* 3(3):1176–1195.

Wilhelmi, Olga V, Donald A. Whilhite. 2002. Assessing vulnerability to agricultural drought: A Nebraska case study. *Natural Hazards* 25(1):37–58.