Eco-friendly diets should also factor foods' impact on water resources

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A new study by researchers from Tulane and the University of Michigan calculates the "water scarcity footprint" of diets by examining the irrigation water required to produce foods and the relative scarcity of water where the irrigation occurs. Photo by iStock.

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If you're celebrating [Earth Day](#) by adopting a more sustainable diet, researchers at Tulane and the University of Michigan have a new aspect to consider when evaluating whether certain foods are good for the planet — your diet's "water scarcity footprint."

The metric looks at how much water it takes to produce certain foods, especially if freshwater is scarce. The researchers examined the water-use impacts of individual diets in the United States, while taking into account regional variations in water scarcity, for a [new study in *Nature Food*](#).

They found meat consumption is the top contributor to the water scarcity footprint of the average U.S. diet, accounting for 31% of the impacts. And within the meat category, beef's impact on water is about six times higher than chicken's, according to the study.

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>
> *Diego Rose, study co-author*

But other foods that require lots of water or that are mainly grown in regions where water is scarce—including certain fruits, tree nuts and vegetables—also have high water-scarcity footprints. High-water-intensity crops include almonds, walnuts, cashews, lemons, avocados, asparagus, broccoli and cauliflower.

"The water-use impacts of food production should be a key consideration of sustainable diets. But until now, little has been known about the water-scarcity demands of diets—especially the diets of individuals," said study co-author and overall project principal investigator Diego Rose professor of nutrition and food security at Tulane University School of Public Health and Tropical Medicine. "There is a lot of variation in the way people eat, so having a picture with this sort of granularity—at the individual level—enables a more nuanced understanding of potential policies and educational campaigns to promote sustainable diets."

The study combines the types and quantities of foods in the diets of individuals, the irrigation water required to produce those foods, and the relative scarcity of water where the irrigation occurs.

The study includes examples of dietary substitutions that consumers can make to reduce their personal water scarcity footprint. For example, they can:

- Replace some high-water-intensity tree nuts with peanuts or seeds.
- Limit consumption of high-water-intensity vegetables and replace them with lower-intensity vegetables such as fresh peas, Brussels sprouts, cabbage and kale.
- Replace some beef with other protein sources, such as chicken, pork, soybeans, dry edible beans, peanuts or sunflower seeds.

"Beef is the largest dietary contributor to the water scarcity footprint, as it is for the carbon footprint," said study lead author Martin Heller of the Center for Sustainable Systems at University of Michigan's School for Environment and Sustainability. "But the dominance of animal-based food is diminished somewhat in the water scarcity footprint, in part because the production of feed grains for animals is distributed throughout less water-scarce regions, whereas the production of vegetables, fruits and nuts is concentrated in water-scarce regions of the United States, namely the West Coast states and the arid Southwest."

The concept of the water scarcity footprint is akin to the more familiar carbon footprint, which estimates the greenhouse gas emissions produced by specific human activities, products and processes. One key difference: greenhouse gas emissions boost levels of heat-trapping gases globally, while the impacts of dietary choices on water scarcity are mainly local.

A handful of previous studies have looked at how variation in dietary choices influences water scarcity, but most do not recognize the impacts of regional differences in water scarcity, even though irrigation in the United States is highly regionalized, with 81% of the water use occurring in 17 Western states.

The new analysis looked at the irrigation-water demands of 160 crops, taking into account water-scarcity conditions at the watershed level. Scarcity-weighted water-consumption data were used to establish a water-scarcity footprint for each crop.

The individual crop footprints were then aggregated to the national level and linked to dietary-choice data from the federal National Health and Nutrition Examination Survey (NHANES), which looked at the dietary choices of 16,800 Americans.

"Our approach is novel in that it links individual dietary choices with the water scarcity-weighted impact of irrigation for specific crops at the watershed level, thus offering insight into the distribution of impacts across a population," said study co-author Greg Keoleian, director of the Center for Sustainable Systems at U-M's School for Environment and Sustainability.

To further investigate how dietary choices impact water scarcity, the researchers ranked all of the individual diets by their water scarcity footprint—from lowest impact to highest impact—then divided those diets into five equal groups, or quintiles.

The diets of individuals in the highest-impact quintile accounted for 39% of the overall footprint—a contribution 4.7 times greater than diets in the lowest quintile. Individuals in the top quintile consume large quantities of beef and higher-than-average amounts of tree nuts and high-water-intensity fruits and vegetables, according to the study.

The study was also co-authored by Amelia Willits-Smith of Tulane and Tara Mahon of University of Michigan.