Meat Production Is Draining the World's Water Supply

By Daniel Tsadok

"The journey of raising beef is among
the most complex of any food."
--Pennsylvania Beef Council

As the planet continues to heat up, responsible water management is more important than ever. Mexico City is currently experiencing a severe water crisis. So is Johannesburg. Meanwhile, freshwater usage has surged globally in the past half century. "Renewable internal freshwater resources" per capita has decreased from 1970 to 2019 by astonishing numbers: 37% in high income countries, 61% in middle income countries, and 84% in low income countries. There has been a decrease of 59% across the world.

It may not be surprising that globally, agriculture is the biggest consumer of water on the planet, but what may be surprising is the extent. According to Hannah Ritchie and Max Roser, "Globally, we use approximately 70 percent of freshwater withdrawals for agriculture."

Before continuing, it is important to note that most scientists distinguish between different forms of water. Two of these are "blue water" and "green water". The fresh water we use every day, and that exists in rivers, lakes, streams, reservoirs etc., is blue water, and for the sake of this discussion, we can consider green water the level

of moisture in the soil and air, including rain. As important as blue water is, and as much as we depend on it, green water is essential for agriculture, and therefore our survival: higher levels of green water mean richer soil and more rainfall, as well as less of a dependence on blue water for crops. For example, not needing to water the garden (using blue water) after it rains (green water). There is also "gray water", which is wastewater (excluding sewage) and other water not fit for human use that would typically go down the drain but can be repurposed for various purposes in agriculture.

With that in mind, we can consider the water footprint of various foods. For example, the Water Footprint Network estimates that wheat requires 1,279 liters of green water, 347 liters of blue water, and 201 liters of gray water per kilogram of grain. Rice requires 1,698 liters of green, 499 liters of blue, and 275 liters of gray per kilogram. Potatoes require 189 liters of green, 32 liters of blue, and 63 liters of gray. When it comes to meat, chicken meat requires 3,545 green, 313 blue, and 467 gray, and cow meat requires 14,400 green, 550 blue, and 450 gray. One the most water-intensive foods turns out to be almonds, which require approximately 4,026 liters blue water, 2,321 liters green water, and 6,637 liters gray water per kilogram of kernels.

It is important to note that water usage for agriculture can vary greatly by country, and that these numbers (except the ones for almonds) are global averages. There are other variables, like whether cows are raised in a factory setting (in which case their feed will have more grains and require more blue water), or a pastoral setting (in which case their feed will have more hay and require more green water).

Scholars often won't take green water usage into consideration when calculating water footprints, because "To a greater or lesser extent, absolute green water flows, relating to evapotranspiration from pastures and crops, are part of the natural hydrological cycle. As such, these absolute green water flows are not considered water consumption attributable to the livestock system for the purposes of impact assessment" (source). In other words, they argue that the rain would be falling on that land whether or not it is used to feed cows, and that it is currently impossible to measure the effects of using green water for pasture versus, say, forest.

That approach may be necessary when quantifying the water impacts of specific activities on a community. However, it is clear that when rainforests are razed for the sake of pastures, there is likely to be an accompanying reduction in rainfall:

> Human-induced vegetation can significantly change the volume of water that is evaporated or transpired into the atmosphere in comparison to potential natural vegetation... For instance, deforestation reduces the surface roughness and leaf area, which in turn limits the green water flows recycled into the atmosphere, thereby contributing to a decrease in precipitation levels (Pielke et al., 2006, Van Dijk and Keenan, 2007).
> "A contribution to the environmental impact assessment of green water flows", by Quinteiro, Dias et al

Another article notes that "Recent research has highlighted the threat posed by deforestation to the Nile River, the world's longest river, and the 300 million people who depend on it." It also

points out that "the rivers of moisture in the atmosphere are rarely measured and never governed."

In other words, it may not currently be possible to quantify the effects of relying on the vast quantities of green water needed for raising beef, but it is qualitatively clear that producing beef, particularly when forest land is razed for animal feed, has an adverse effect on total water availability. The same article that advises against including green water for impact analysis also asserts that “The careful management and use of green water are... paramount to safeguard food production and sustain terrestrial and freshwater ecosystems.”

Even if we don't consider how land use may affect the availability of water, beef remains an extremely water inefficient food. The reason for this is that cows typically need to eat thousands of pounds of food over their lifetime, which is about 6 months to two years for beef cattle (cows naturally live for 15-20 years). For all that feed, according to UNL, "A 1400-pound beef animal will yield a hot carcass weight of approximately 880 pounds. Once cooled, the carcass weight will be approximately 840 pounds. When deboned and trimmed, there will be approximately 570 pounds of product to fill your freezer."

The same amount of water, including the green water, that is used to produce 1 kilogram of beef could instead be used to grow about 8-10 kilograms of wheat, or close to 38 kilograms of peas. As the Water Footprint Network puts it, "Per kilogram of product, animal products generally have a larger water footprint than crop products. The same is true when we look at the water footprint per calorie or protein. The average water footprint per calorie for beef is twenty times larger than for cereals and starchy roots.

The average water footprint per gram of protein in the case of beef is six times larger than for pulses."

Based on the calculated water footprints, the same water currently being used to produce 76 million metric tonnes (168 billion lbs) of beef could instead be used to grow 600 million metric tonnes (1.3 trillion lbs) or more of wheat, or almost 2,900 million metric tonnes (6.4 trillion lbs) of peas, for people. In other words, we could drastically increase total food production with the same amount of water by reducing beef and other meat production.

Mekonnen and Hoekstra write that, "In order to reduce the pressure on the world's water resource associated with their consumption pattern, individuals have the option of shifting from a meat-rich to a vegetarian diet. The water footprint of an individual consumer depends to a large extent on the type of diet of the individual... Replacing 50% of all animal products by an equivalent amount of high nutritious crop products such as pulses, groundnuts and potatoes will result a 30% reduction of the food-related water footprint. A vegetarian diet compared with the average current per capita food intake in the USA can reduce the water footprint of an individual by as much as 58%."

In addition to being an enormous water drain, meat production is also an enormous contributor to pollution, deforestation, habitat loss, and carbon emissions. There is the waste, in the form of manure, that raising billions of cows inevitably produces. If not managed correctly, it can affect the local (blue) water supply as runoff.

Ritchie and Roser write elsewhere that "If we combine global grazing land with the amount of cropland used for animal feed, livestock accounts

for 80% of agricultural land use. The vast majority of the world's agricultural land is used to raise livestock for meat and dairy. Crops for humans account for 16%. And non-food crops for biofuels and textiles come to 4%. Despite the vast amount of land used for livestock animals, they contribute quite a small share of the global calorie and protein supply. Meat, dairy, and farmed fish provide just 17% of the world's calories, and 38% of its protein." They add, "the area of land used for livestock — including grazing land and croplands for animal feed — is as large as the entire Americas... By shifting towards more plant-based diets, we would save large amounts of land through reductions in grazing land, and croplands for animal feed... This would be a huge win if we want to preserve the world's biodiversity." Finally, Project Drawdown estimates that if 50% of the population were to transition to a "plant-rich diet", it would reduce emissions of "carbon dioxide equivalent gases" by over 78 gigatons (172 trillion pounds) over 30 years.

There is ample evidence that meat production is taking an enormous toll on our water supply and the planet. While many of us may enjoy and even love eating meat, it is imperative that as a society we take a serious look at the cost of doing so in vast quantities.

Disclosure: The author is a shareholder of Beyond Meat. He bought shares after hearing a talk by the founder, Ethan Brown, about how plant-based meats can significantly benefit the planet by reducing the negative impacts of animal-based meat.