‘Corn Sweat’ as an Ecosystem Service

Estimating the financial and environmental benefits to the Midwest

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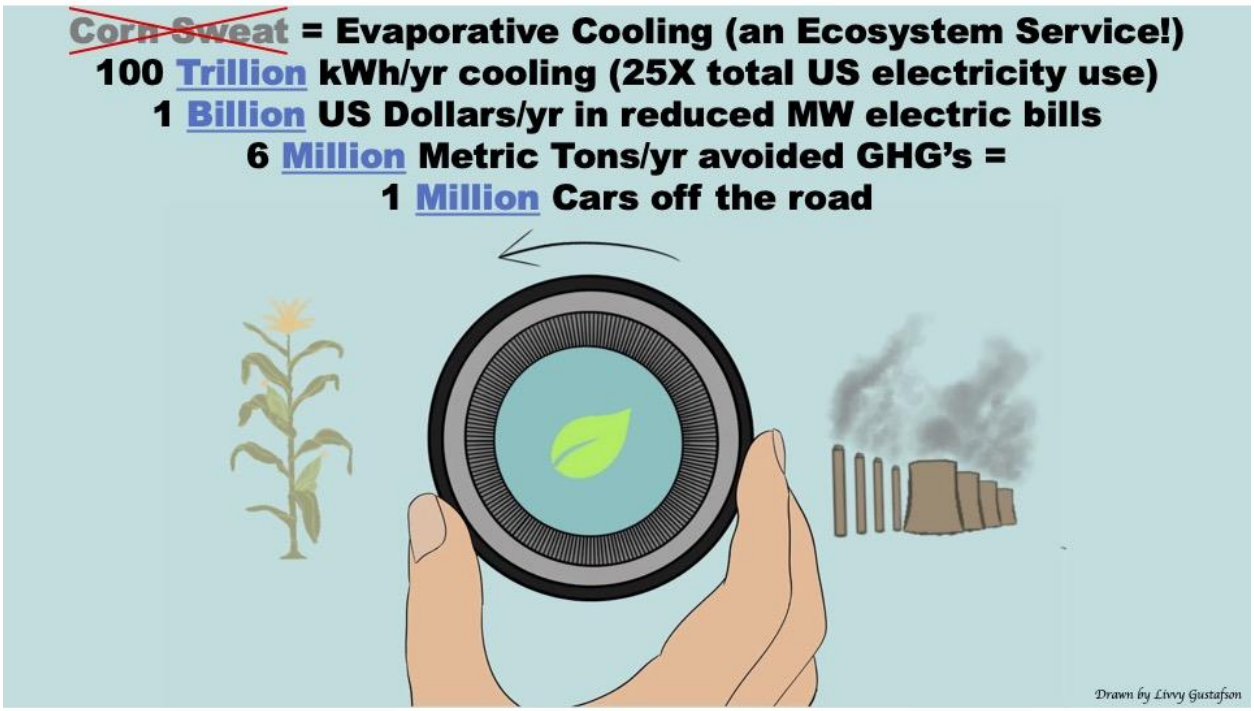
In a recent post (from September 6), I confronted and directly refuted the myth that ‘corn sweat’ was somehow contributing to the sweltering conditions in the Midwest, because those peddling this ‘junk science’ were completely ignoring the beneficial effect of evaporative cooling. But now I’m taking the analysis a step further, by estimating the financial and environmental benefits that corn delivers to the Midwest, in the form of lower electricity bills and reduced GHG emissions.



As before, getting all of the calculations 100% accurate on this question would take at least one or two Ph.D. dissertations, and I certainly won’t burden the reader with that. But the basics are just as simple as before. All of the water that evaporates from a corn field – whether from the soil or from the plant itself – necessarily takes thermal energy (scientists call it the ‘latent heat of vaporization’) out of the corn-soil-air system, converting it into the increased kinetic energy of the escaping water molecules. The more evaporation, the more cooling. If your head is bald like mine, you feel this on a sunny day when you remove your cap. You feel the immediate cooling until all the beads of water have evaporated.

The sum of water evaporating from the soil and from the plant is known as ‘evapotranspiration’ or ET, for short. As shown in the figure that follows (from Iowa State U Extension), the higher the corn yields, the higher the ET. As corn yields have continued to grow through the decades (they averaged only 50 bu/A in 1958, when I was born), this has dramatically increased the amount of cooling that corn delivers to the Midwest. And it is a LOT of cooling. Using last year’s average US corn yield of 177.3 bu/A (yet another new record), it equates to 18 inches of ET or 500,000 gallons of evaporated water per acre per season. Multiplying that by 90,000,000 acres of corn gets

us to more than 100 Trillion kWh per year of cooling. That is 25 times higher than the total amount of current electric power generation for the entire US!

Higher corn yields require more water transpiration and therefore more evapotranspiration (Figure 3). Typically, a 150 bu/ac corn uses 16 inches of water, 200 bu/ac corn uses 20 inches of water, and 250 bu/ac corn uses 22 inches of water. For every inch of evapotranspiration corn yield increases by approx. 17 bushels.

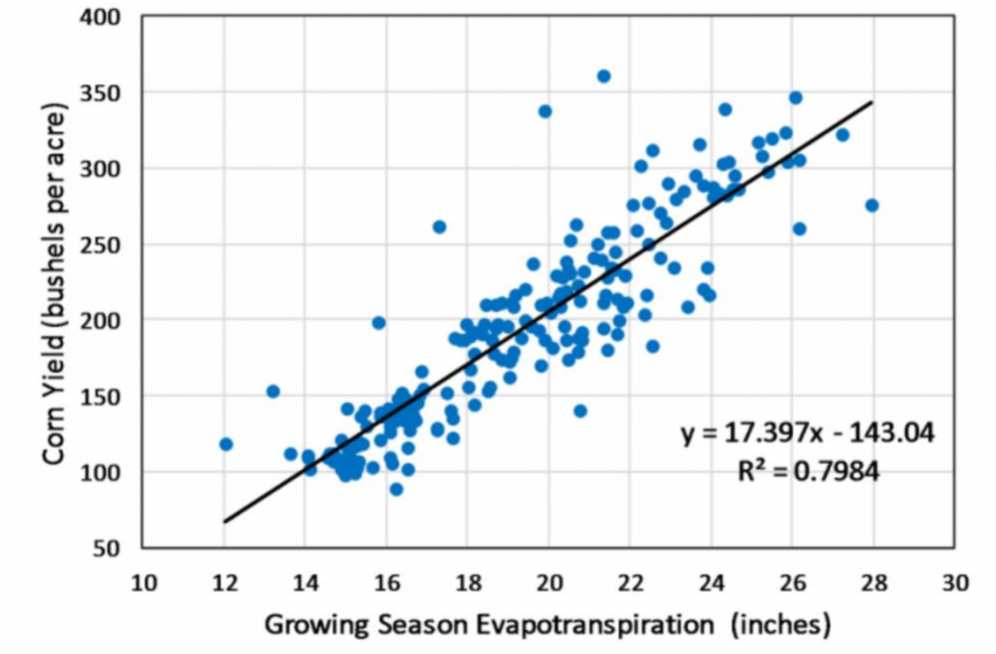


Figure 3. Relationship between corn yields and evapotranspiration.

In the September 6 post, I conservatively estimated the amount of cooling of urban areas as being 3.4°F. According to many public sources of information, such as the US Energy Information Administration, the amount of energy needed to provide cooling decreases by 1-3% for every 1°F that a thermostat is adjusted higher. So we can derive a first estimate of the energy savings by simply multiplying the cooling (3.4°F) by 2, giving us 6.8% in savings for the Midwest.

As indicated in Table 1 (next page), current electric power consumption for cooling the Midwest is around 118 Million kWh. The current cost of that electricity is $0.167 per kWh. Reducing power consumption by 6.8% thus results in annual savings of a little more than one billion dollars. The mix of energy generation is still coal-heavy in the Midwest, with a carbon intensity of around 1.5 pounds CO_2 per kWh, meaning that the GHG savings associated with this reduced need for cooling is around 6 million metric tons, equivalent to taking more than a million cars off the road.

So in about 9 months, when you next hear a midwestern weather broadcaster erroneously blame 'corn sweat' for why it feels so muggy and hot outside, please join me confronting this false allegation! And rather than hugging a tree, perhaps we should each hug a corn plant for the unappreciated and unvalued ecosystem service that it provides, particular as climate change continues to make summers in the Midwest even more uncomfortably hot. Yes, I realize corn plants can be a little prickly to hug, but so is your Aunt Mildred. And you still hug her, right?

Table 1. Summary of Assumptions and Calculations

Yield	177.3	bu/acre	National average
Seasonal ET	18.41	in/yr	Formula given by Iowa State: https://crops.extension.iastate.edu/cropnews/2017/06/corn-water-use-and-evapotranspiration
	500,001	gallons/acre/yr	
ET Cooling	4,000,005,684	BTU/acre/yr	
US Corn	90,000,000	acre/yr	
Total Evaporative Cooling	3.60001E+17	BTU/yr	
	1.05506E+14	kWh/yr	
	105,506	B kWh/yr	
Net Cooling Benefit	3.4	°F	From model in September 6 post
Reduction in Cooling Electricity	6.8	%	Based on the "rule of thumb" of 1-3% energy saving per degree F
MW Cooling Electricity	118.3	B kWh/yr	https://www.eia.gov/tools/faqs/faq.php?id=1174&t=1
Avoided MW Cooling Electricity	8	B kWh/yr	
Financial Savings	$1,346,912,102	USD/yr	https://www.bls.gov/regions/midwest/data/averageenergyprices_selectedareas_table.htm ($0.167 per kWh in August 2024)
Avoided GHG's	12,098,012,888.85	lb CO_2/yr	Assuming 1.5 lb CO_2/kWh: https://www.eia.gov/tools/faqs/faq.php?id=74&t=11
	5.488	MMT/yr	
	1,192,951	Cars	4.6 metric tons CO_2e/yr per car: https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle