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Irrigation Water Consumed per Gallon of Corn Ethanol Produced in the Texas High Plains

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The national priority for renewable energy led to policies to encourage conversion of feed grains (particularly corn) to ethanol. The combined effect of biofuel subsidies and the Renewable Fuels Standard substantially increased the demand for corn and thus increased the relative price of corn. Higher corn prices provided incentive for farmers in irrigated regions such as the Texas High Plains to shift some acreage from cotton and other crops to corn. Unintended consequences are associated with such policies. In this case, more water efficient crops such as cotton and wheat were reduced in favor of water intensive corn. This paper presents estimates of the amount of irrigation water required per gallon of ethanol on the Texas High Plains.

Based on the Seawright, et al, (2010) study, the typical yield of corn in the region is approximately 200 bushels/acre. For purposes of comparison, yield levels of 160, 200, and 240 bu/ac are considered in this analysis. Conversion of corn to ethanol assumes 2.8 gallons of ethanol per bushel of corn (Dhuyvetter, et al 2008). Therefore, gross ethanol production is 448 gallons/ac for a corn yield of 160 bu/ac, 560 gallons/ac for 200 bu/ac corn, and 673 gallons/ac with 240 bu/ac corn yield.

The Texas A&M AgriLife Extension crop budgets indicate an irrigation level of 22 acre-inches. For sensitivity purposes, three irrigation levels are presented since annual amount of water applied varies by year and by farm. Levels considered are 12, 17 and the 22 acre-inches. One acre-inch of water is equal to 325,848 gallons. This means the gallons of irrigation water per acre are 3.91 million, 5.54 million and 7.17 million gallons for 12, 17 and 22 acre-inches of irrigation.

Table 1 shows the gallons of irrigation water from the exhaustible Ogallala Aquifer applied per gallon of ethanol, not including water needed for distillation and not including rainfall.

Based on the expected 200 bushels of corn per acre with 22 acre-inches of irrigation, the water expended per gallon of ethanol is nearly 13,000 gallons or over 1/3 of an acre-foot. The range across the alternative scenarios is from a low of 5,819 to a high of 16,001 gallons of water per gallon of ethanol. Keep in mind that irrigation water consumption figures in Table 1 are for gross, not net, energy production from corn ethanol.

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Table 1. Gallons of irrigation water per gallon of corn ethanol on the Texas High Plains			
Corn Yield (bushels/acre)	**Irrigation Level (inches per acre)**		
	12	**17**	**22**
160	8,728	12,365	16,001
200	6,982	9,892	12,843
240	5,819	8,243	10,668

Seawright, et al, (2010) evaluated the *net* energy balance of producing irrigated corn for ethanol. Under all scenarios evaluated, there was a net BTU energy balance ranging from negative 7% to negative 33%. In other words, there was a loss of fossil fuel energy.

Irrigated corn for ethanol in the Texas High Plains wastes energy and wastes water from the exhaustible Ogallala aquifer.

These negative tradeoff need to be recognized in future farm program and energy policy deliberations.

References

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