A Gorged Appetite

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ABSTRACT: *This study was completed at a time when ethanol was considered to be a comparable fuel source. Environmental awareness was at a high among American citizens and concern about oil imports and high gas prices overshadowed most other national concerns. There was a national debate about ethanol, the new fuel alternative. Many items presented in this study at the time were known to but a few, these same items are now more widely researched and understood. Still it is not the intent of the study to inform on a single fuel alternative but rather to demonstrate that any fuel alternative will have much deeper ramifications that most interested parties, advocates, and policy makers are more likely to acknowledge.*

"When the well's dry, we know the worth of water."
—*Benjamin Franklin*

"Be glad that you are greedy; the national economy would collapse if you weren't."
—*Mignon McLaughlin*

There is a powerful political and societal movement to increase environmental awareness and preservation efforts. One of the more prevalent and pervasive is the alternative energy movement, driven by global warming concerns. The movement's heralds condemn the consumption of oil and fossil fuels, saying that they harm the environment. This study examines the possibility that perhaps it is not our consumption of fossil fuels specifically that is the problem but rather the level of consumption itself. To understand this point one must examine some of the developments in ethanol production and implementation, farming practices that will be affected by it, and possible effects this will have on water resources and water usage. The last item is something to which many in the Texas Panhandle can easily relate.

As national markets and economies continue to grow, so too do the massive amounts of energy and materials that feed it. In recent years many people said that there is a flaw in our current practice of predominantly using fossil fuels. There are several concerns regarding fossil fuel use, most prevalently: it is a non-renewable resource because fossil fuels take millennia to form and burning them contributes to greenhouse gases. As a result many forms of alternative energy have been developed.

The front-runner of these—in terms of practicality and ease of integration into existing infrastructure—is ethanol, which constitutes about 99% of all biofuels in the United States. In 2004 "the 3.4 billion gallons of ethanol blended into gasoline amounted to about 2% of all gasoline sold by volume and 1.3% of its energy content" (Farrell, Plevin, Turner, Jones, O'Hare, & Kammen, 2006, p. 506). I would like emphasize again that my purpose here is not to promote or criticize a particular type of energy, energy policy, or farm practice. Nor is my focus on what is being consumed but rather the consumption levels in particular.

Ethanol is meant to decrease the consumption of oil. There is a panoply of reasons that various organizations call for this conversion of fuel sources, but four primary ones may be identified. The switch to ethanol will improve air quality, decrease greenhouse gases, reduce reliance on foreign oil, and provide a less expensive fuel (Patzek, Anti, Campos, Ha, Lee, Li, et al., 2005; Wald, 2007). In 2005, the United States consumed 20.6 million barrels of oil a day—almost a quarter of the 82.4 million barrels that the world consumed on average each day that same year (BP, 2006). That is the total amount of oil consumed. But if the scope is narrowed to gasoline used in motor vehicles, in 2006 alone the United States used 140 billion gallons of gasoline (Wald, 2007). Because of these increased concerns the "U.S. has gone on an ethanol binge" (Wald, 2007, p. 44). In August of 2005, the United States Congress passed legislation that called for the production of 7.5 billion gallons of ethanol a year by 2012 (Wald, 2007). The United States government urges the conversion to ethanol by providing for a 51¢ per gallon tax credit to be awarded to consumers of ethanol purchased as motor fuel (Farrell et al., 2006). In addition, with the Energy Policy Act of 2003, Congress in the eyes of some suspended purely free market practices by creating "an artificial market for ethanol," calling for the states to use five billion gallons of ethanol annually by 2012 (Coon, 2003).

Obviously much effort is being put into the development and implementation of ethanol. But will it really get rid of a problem that our current consumption of gasoline and oil has supposedly created? An analysis of each reason for the conversion from gasoline to ethanol is the crux of the situation. The only reason for the comparison to gasoline and oil specifically is because no other energy source has been harnessed to the extent that gasoline and oil have. Since ethanol is being promoted as a gasoline substitute and supplement the nation must consider its implementation on a large scale as well.

One reason for the switch is to decrease reliance on foreign oil. According to the Renewable Fuels Association, consuming 7.5 billion gallons of oil a year (the projected amount for 2012) would mean 179 million fewer barrels of foreign oil per year. That would be about 15 days of imports—so it is a start if not "a cure all" (Wald, 2007, p. 46). The ease of justifying ethanol ends there.

There has been controversy regarding the other three reasons based on whether or not a switch to ethanol would actually be an improvement. This examination includes issues concerning greenhouse gases, air quality, and the energy input and output of ethanol production. Because there is such a controversy regarding the way to analyze production and results, one attempting to do research must be very cautious when finding sources. To this end, the Energy and Resources Group of the University of California led by Alexander Farrell evaluated six representative analyses of fuel ethanol.

Their findings were that the discrepancies in research depended, primarily, on whether the researchers included co-products of ethanol into their equation of ethanol's net energy output or not. Farrell et al. argue that these "co-products of ethanol have positive economic value and displace competing products that require energy to make" (2006, pp. 506–507). The co-products provide energy because they can be fed to livestock, lowering the need to grow some corn—thus the displacement (Wald, 2007). Those who assigned a higher energy input than energy output into the creation of ethanol disregarded this. There were other discrepancies in research regarding what should be included in calculating energy output, but as Wald (2007) noted, "the consensus among the analysts is that even if the net energy value of ethanol is positive the margin is small" (p. 47). This was a recurring theme in research for this study.

Regarding greenhouse gases, Farrell et al. (2006) showed the impact of developing gasoline versus developing ethanol by developing "[n]ew metrics that measure specific resource inputs" (p. 506–507). Farrell looked at the impact of four inputs in his calculations: petroleum, natural gas, coal, and other. Then he gave "other products" a negative effect on the five inputs. Gasoline requires 1.1 mega joules (MJ) of petroleum per MJ of fuel, 0.03 MJ of natural gas per MJ of fuel, 0.05 MJ of coal per MJ of fuel, and 0.01 MJ of other inputs per MJ of fuel. Accordingly, ethanol today requires 0.05 MJ of petroleum per MJ of fuel, 0.3 MJ of natural gas per MJ of fuel, 0.4 MJ of coal per MJ of fuel, and 0.04 MJ of other inputs per MJ of fuel. The result of these inputs applied to greenhouse gases applying the effect of the "other products," result in a 94 kg CO_2 equivalent per MJ of fuel for gasoline and an 81 kg CO_2 equivalent per MJ of fuel for ethanol—carbon dioxide is used because the study takes into account other emissions that, while not carbon dioxide, have the same greenhouse gas effect. On paper this looks good, but Wald (2007) pointed out that "Farrell and his co-authors concluded that ethanol made with natural gas is marginally better than gasoline production for global warming pollutant, but ethanol made with coal is worse" (p. 47). Disregarding the issue of greenhouse gases, the coal drastically increases airborne pollution.

Though their findings could be considered favorable towards the implementation of ethanol, Farrell et al. (2006) maintain that "it is already clear that large-scale use of ethanol for fuel will almost certainly require cellulosic technology" (p. 506). That was the other recurring theme between both proponents and critics: cellulose ethanol. Every source indicated that cellulose ethanol would be very efficient and clean. However, the process of creating cellulose ethanol is very difficult and has erratic results. And while some companies have had their production process work, "it does not appear that any has done so with enough consistency to persuade lenders" (Wald, 2007, p. 49).

Another fairly non-contested item is that even with production geared towards packing BTUs into the ethanol the best outcome that has come about, with current technology, is about 80,000 BTUs. Compare this to the 119,000 BTUs found in unleaded regular (Wald, 2007). The result of this is that a standard barrel (about 42 gallons) of ethanol is worth, energy-wise, about 28 gallons of gasoline (Wald, 2007). According to Wald (2007), the result of this is a situation where "even if a gallon of ethanol were cheaper at the pump, drivers would have to buy many more gallons to go the same distance" (p. 46). That in turn would require larger gas tanks. Patzek et al. (2004) corroborated this assesment, maintaining that since ethanol "has a 34% lower heating value . . . about 1.5 gallons of ethanol are required to replace the energy in one gallon of gasoline . . . to drive on ethanol an average 15-gallon fuel tank in a car must swell to 23 gallons" (p. 320).

Wald cites a letter that David Pimentel—an advocate and longtime student of ethanol research and development—sent to Senator John McCain (R-AZ) in 2005. Pimentel stated that producing 3.4 billion gallons of ethanol was consuming about 14% of the total American corn crop which was an estimated 11.8 billion bushels (U.S. Department of Agriculture National Agricultural Statistics Service [USDA], 2005; Wald). Fourteen percent of this would be about 1.65 billion bushels. Pimentel says, "At this rate . . . 100 percent of the nation's corn crop would supply only 7 percent of the fuel consumed by its vehicles" (Wald, 2007, p. 48). According to the Department of Agriculture that 11.8 billion bushels was made on 80.9 million acres (USDA, 2005).

These trends, in a purely hypothetical scenario, can create interesting results. Assume for a moment that the 80.9 million acres which produced the corn crop in the 2005 report are the most suited to growing corn and that is the reason the farmers on those particular tracts of land are growing it. Consider the implications if someone were able to engineer genetically a corn that will grow with that same productivity and energy potential anywhere in America. In addition, consider what would happen if all the farmers of America feel particularly patriotic and decide to help the ethanol initiative by growing exclusively corn. The result of this type of action, while not practically executable, might not be extending too far into the realm of fantasy. Corn prices are the highest they have ever been in the history of United States agriculture, which might be enough to persuade farmers to switch from their traditional crops (National Corn Growers Association [NCGA], 2007). If every acre of American farmland, last counted at 304.6 million acres, were converted to corn and the harvest was the same as it was in the area which is best suited to farming corn, the result would be 44.4 billion bushels of corn (USDA, 2005). That astronomical number if all put into ethanol production would only satisfy about 26% of the fuel annually consumed by vehicles in the United States. This hypothetical situation contains ambiguous variables that may lead agricultural energy experts to question the validity and scholarly application of its results. However, the numbers used from current trends are sound and simply being subjected to expansion of scope. When utilized in such a way the results can demonstrate valid concern for ethanol's ability to satisfy issues of scale. One must remember the purpose of this theoretical paper is to investigate the advantages and disadvantages of alternative energy fuels as a form of energy and its impact on various markets. And that increased demand is a reality because the policy is government mandated. According to the plan, the states will buy five billion gallons of ethanol in 2012. The corn to produce that ethanol must come from somewhere.

Following this scenario, my second major focus is to examine some of the effects this conversion to ethanol might have on farms and farming practices. The National Corn Grower's Association (2007) reported that for "the 2006/07 marketing year, more than 2.1 billion bushels—or twenty percent of the 2006 corn crop—[were] used for ethanol production" (p. 2). Moreover, the increases that corn production systems are going through are staggering. In almost a single year the price of corn has come close to doubling. The cash-price of corn in Illinois in January 2006 was $2/bushel. As of February 2007 it was pushing $4/bushel (NCGA, 2007). To examine more closely the impact on the Texas Panhandle several local farmers were interviewed.

Landon Friemel (personal communication, April 15, 2007), whose farm is located northwest of Umbarger, TX, explained some of the repercussions of these prices to farms around this area. He said currently his family's farms are not producing corn. The quality of a corn crop relies heavily on water and would require him to irrigate more extensively than he currently is. Though his own farm does have the means to irrigate, it currently would be too expensive in terms of fuel costs for pumps to pump out water from the Ogallala. When asked how farms in Dalhart, TX were able to maintain the level of irrigation required to make corn, he replied because the section of the Ogallala under them is much more porous and does not require as much fuel to extract. Here he answered that the sand content under his farm makes the fuel costs much greater. When asked, "If prices of corn kept increasing would it justify a switch to corn?" Friemel answered, "Yes." Friemel said his farm would probably not be the only one that would make a switch if prices kept going up, simply because the extra operating costs would not be as much of a deterrent with the extra revenue for those pumping for water in less porous sections of the Ogallala. Purdue University agricultural economist Chris Hurt said that

> "In terms of acreage, I've been suggesting that we may have to push acreage up to . . . eighty-nine million acres of corn. That would be a ten million acre increase from 2006 and would put us at the highest acreage planted to corn in the United States since 1946. We'd be looking at a sixty-year phenomenon." (Leer, 2006, para. 4)

This would be in response to the ethanol movement if indeed there were a higher demand, which there will be with government-mandated purchasing of ethanol. The United States does not import corn; most countries that do import corn do so from the United States. So where will the corn for ethanol come from? The reason for my essay's hypothetical scenario is suggested by Leer (2006): "Should farmers follow the economic trends and dramatically increase their corn acres, they'll have to grow fewer acres of other crops" (para. 15). And some more serious repercussions come up as Leer then discusses reduction in acreage for cotton, sorghum, wheat, and soybean crops. Leer notes that Hurt maintains that with prices as good as they are farmers might plant the same crop several years in a row. "Planting corn for a second straight year on the same land would disrupt crop rotations, which could mean reduced yields. . . . Still, the markets say grow corn"(Leer, 2007, para. 18).

Another local farmer, Tyler Thompson, was asked about this type of farming practice which might risk causing soil degradation. When asked if some farmers in the face of such greater profit might abandon some conservation efforts for more short-term high-yield practices, Thompson replied, "there are already a lot of those 'high yield' practices going on. I mean a lot of farmers have the outlook that they need to make money while they can, before the water is all gone, or before diesel is four dollars a gallon" (personal communication, Aprl 16, 2007). This supports Leer's predictions.

To see some possible effects on farm soils I interviewed retired district conservationist Darwin Schrader. Schrader worked in Texas for the Soil Conservation Service (SCS) in the Glasscock County and the North Concho River soil and water conservation districts. In addition, Schrader was a private soil conservation consultant. In total he had 35 years of experience in soil conservation. Schrader explained that corn requires large amounts of all three of the major corn nutrients—nitrogen, phosphorous, and potash. So the fertilizer for corn must be rich in all three—unless one of them occurs naturally in an area or due to crop rotation nutrients are put back in the ground. The two factors we can control in order to put nutrients back in the soil are fertilizer and crop rotation. Of these two, the one that has the potential to take the longest is crop rotation. Schrader explained the situation by comparing corn growing in Nebraska and in Texas. Schrader said that in Nebraska, when a corn crop takes large amounts of nitrogen from the soil, the next planting season the farmers will grow soybeans or other legumes because these plants pluck nitrogen from the air and put it back in the soil. These kinds of practices though they sacrifice a year of producing a higher priced crop save money by reducing fertilizer costs. In Texas the sacrifice is larger.

Since soybeans do not grow well in the Texas climate, most corn producing farms rotate their crops with alfalfa. Alfalfa puts nitrogen back in the soil but does so in a two-year rotation. Putting nitrogen back in the soil while still producing a crop that can be sold is useful because for nitrogen to be used in fertilizer form it must bond with natural gas which makes it very expensive (over $400 a ton). When asked if corn prices were at an unprecedented high might farmers abandon crop rotation practices? Schrader confirmed Leer's assessment. Schrader said one must understand the situation the farmer is in: at this time the profit from corn would simply pay for nitrogen rich fertilizer that could substitute for the crop rotation. The farmer does not know that the prices will stay that high; the agriculture market is fickle. So the farmer would take advantage when the opportunity arose. However, Schrader also talked about the results of this:

> In any monoculture you have a build up of diseases, weeds, and insects, these factors would eventually decrease crop yield no matter the amount of fertilizer or irrigation used simply because they become resistant to techniques used to protect the crops. Eventually without the use of catch-me crops or reversion back to crop rotation, there would not be enough yield to make a profit even at these higher corn prices. (personal communication, May 6, 2007)

It is also noteworthy to examine the impact this would have on other industries that rely on corn. "Corn is the primary feed used to produce protein, dairy, and egg products in the United States" (NCGA, 2007, p. 2). The reports from Farrell would indicate that livestock feed would not be impacted by this and while the impact according to the NCGA is minimal, this research shows the impact can be attributed to the fact that not every production technique for ethanol is the same.

Some ethanol plants might not have the same by-products as readily available for livestock feed as other ethanol plants might. Whatever the discrepancy between reports, the NCGA (2007) has reported that

> even if corn prices remain at the $3.50–$4.00 per bushel level for a sustained period, the impact on consumer food is expected to be minor. For example, one dollar worth of food in 2006 would likely cost the consumer $1.03 in 2007 absent of the rise in corn prices. With the increase . . . one dollar worth of food in 2006 might now cost . . . $1.06–$1.07 in 2007. (p. 2)

The final area of analysis will be the possible impact of corn ethanol production on water sources, a concern to which residents of this area can easily relate. The local farmers interviewed for this study all agreed that water and irrigation are very important to area farming and not just to the production of corn. Indeed, almost all local farms rely on irrigation; so water sources on the high plains are very important. Corn requires a lot of water, thus "ethanol production requires huge amounts of water: thirty-five gallons per bushel of corn" (Patzek et al., 2004, p. 325). For some places in the north and northeast that is not a problem due to adequate rainfall. If, however, corn-farming branches out of its traditional areas into areas like the high plains, area water sources (most notably the Ogallala) will be affected. The impact the conversion from fossil fuels to ethanol might have on the Ogallala is an ironic one since the water in the Ogallala could be considered a fossil fuel. The regions that the Ogallala covers receive so little rain there is almost no recharge on the Ogallala and, according to Robert Glennon (2002), most of the water in the Ogallala was put there ten thousand to twenty-five thousand years ago when the Ogallala was filled to capacity. The pumping of groundwater began from the Ogallala in the 1930s at a reasonable rate. In the 1940s however the "groundwater spigot was opened wide" (Glennon, 2002, p. 25). Technological developments caused the pumping to "increase more than 1,000 percent from 651 billion to 7.5 trillion gallons per year" (Glennon, 2002, p. 26). In the Texas section of the Ogallala alone, the number of wells drastically increased from 8,400 to 42,200 in a nine year period. These wells covered 3.5 million acres of farmland by 1957. Thirty-three years later in 1990, "sixteen million acres of the High Plains were irrigated with water from the Ogallala Aquifer" (Glennon, 2002, p. 26). It was this that allowed for the productivity that gave the High Plains the nickname "the breadbasket of the world," but all of this had a price. By 1980, in parts of Texas and Kansas, the water table had dropped more than 150 feet (Glennon, 2002).

Scientists believe the Ogallala originally held 3 billion acre-feet of water, or approximately 977 trillion gallons. After the binge irrigating between 1960 and 1990, more than a half-billion acre-feet had been pumped out and the remaining water has traditionally not been accessible because of porosity "to justify the costs of recovery" (Ashworth, 2006, p. 25). If the corn growing trend grows, that will soon change. In thirty years the Panhandle pumped out 163 trillion gallons of water, and the corn demand and prices, if stable, will justify going after the rest of it. Why? Currently the Ogallala spans eight states, two of which—South Dakota and Nebraska—are among the nine biggest corn-growing states in the country. In fact Nebraska is the leading producer of corn in the country and though it has only one-third of the Ogallala's total land area it has two-thirds of the total water (Ashworth, 2006).

The evidence points towards a renewed pressure on the water resources of the Texas Panhandle. The current water situation is not good and it is the calm before the storm that will be an ethanol movement, which by all appearances is gaining momentum. One might be led to believe that conservation practices might make farmers and other users of water show some restraint. But as Thompson pointed out that is not necessarily a given. It certainly was not in the 1930s when consequences of irresponsible conduct—the dust bowl—should have been fresh on everybody's mind. It still wasn't always enough to ensure caution. In *Dust Bowl* (1979) Donald Worster describes similarly tenuous situations: "Big-scale progressive farmers . . . who had been among the most eager converts to the SCS program, now led a revolt against advice and interference: they were 'belligerently positive about their ability to take care of their land, no matter what happens'" (p. 226). A quote from the time could just as easily be applied today: "'The voice of the two-dollar wheat is far more persuasive than scientific facts on wind, rain, sun, and soil'" (Worster, 1979, p. 226). In the face of high prices many farmers revert back to whatever will produce the most. In fact the way most of my sources point is that land has traditionally been, for the most part ignored or protected, might now be tilled and farmed. This was also a similar situation to the 1930s: "The grassland was to be torn up to make a vast wheat factory: a landscape tailored to the industrial age. Specialized, one-crop farming became the common practice, and business economics the standard of success or failure" (Worster, 1979, p. 226).

The evidence suggests that even with advances in energy technology we cannot support the appetite we have built up. The appetite we have adopted is not one of sustenance but of gluttony. America is the number one producer of grain. Worster (1979) recognizes this:

> America will play, as it has in the past, the role of international grain supplier, much as the Middle East plays supplier for the oil-hungry. Almost half of all wheat exports in the world now come from our farms. But each year that outside demand will get bigger, until even the American breadbasket will no longer be able to provide enough. (p. 238)

What will be the result when the world's biggest exporter of grain converts many of its crops to satisfy domestic energy needs? We live in a world where even "renewable" resources aren't always practically so. I disagree with Worster on the last point and defer to the words of William Ruckelshaus: "Nature provides a free lunch, but only if we control our appetites." From that perspective Worster might agree. In fact he points out that the appetite is the problem in the final pages of *Dust Bowl*: "The Great Plains cannot be pushed and pushed to feed that world's growing appetite for wheat without collapsing at last into a sterile desert." I agree that is a possibility—a far off and unlikely one—but a possibility because of the corn-ethanol trend. Worster's (1979) advice to that end is still applicable:

> The harder, yet more essential response is to moderate our demands on this limited planet: to learn to discipline our numbers and our wants before nature does it for us. That will require searching reappraisal of the cultures by which we live, not the least so of capitalism. (p. 239)

We also need something else, something that Worster touches on in various parts of his book and that is a focus on the long term. The purpose of these scenarios and theories is not to condemn, or to create a slippery slope, but rather to emphasize that any "solution" to our energy situation, on the scale that it would have to be, will have far reaching ramifications.

In today's fast-paced society many people want to believe "short and sweet" fixes can be enough. But they often aren't. Ethanol, for example, while viably a relief from the strain of greenhouse gases and oil consumption, is ultimately a short term fix at best, and if utilized on a long-term scale would not be able to satisfy our normally gorged appetite.

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