

ETHANOL AND WATER

I. What is the issue? Why are we concerned?

The current boom in ethanol production, in Minnesota and across the United States, has important implications for water quality and, in some areas, for the supply of water. Ethanol some day may be made from prairie grass, algae or other more efficient and less harmful organic substance, but in the U.S. the alcohol fuel now is distilled almost exclusively from corn. Making corn into ethanol threatens surface and sub-surface waters in several ways.

Those threats were outlined in a major report issued in October by the National Research Council.¹ The council focused primarily on ethanol, but also looked at the significantly smaller² biodiesel industry that produces additives, primarily from soybeans, for diesel fuel. The National Research Council's report, titled "Water Implications of Biofuels Production in the United States, is the source for much of the data in this issue briefing. Threats to water described in the report include:

- Corn requires much more nitrogen and phosphorus fertilizers, and twice the pesticide applications, used to produce soybeans. Ethanol-driven price increase for corn undoubtedly have already influenced farmers to switch acres from soybean to corn production, increasing the quantities of those fertilizers and pesticides washing off their fields into streams and rivers and seeping into aquifers.
- To the extent that higher corn prices influence farmers to plow up Conservation Reserve Program acres or other marginal farm land to plant corn, the result is likely to be increased fertilizer runoff, increased erosion and increased sedimentation in waterways.
- The vast majority of corn grown in Minnesota and across the U.S. is not irrigated.³ But, if the higher prices farmers currently are receiving for corn persuaded any significant number of them to turn to irrigation to boost yields or to grow corn in dry areas, the demand on surface and sub-surface waters supplies could increase dramatically. The National Research Council report estimated 780 gallons of irrigation water are required to produce one gallon of ethanol from irrigated corn.
- In the distillation process that turns corn into alcohol, ethanol production plants currently use about 4 gallons of water to produce a gallon of fuel, more than twice the rate of water usage for refining gasoline. In some corn-growing areas, such as southwestern Minnesota, surface and underground water supplies are not adequate to meet the increased demand of an ethanol plant. Cargill dropped plans for an ethanol refinery in Pipestone because of water supply concerns.⁴ The National Research Council report raised concern about ethanol plants that might draw water from the already diminished Ogallala aquifer that runs from west Texas up into South Dakota and Wyoming.
- Ethanol refineries have the same potential other water-intensive industries have to violate water quality standards in the way they treat and discharge waste water. The Minnesota Pollution Control Agency recently fined a Granite Falls ethanol producer

\$300,000, a large fine by the agency's standards, for violations that included exceeding water-quality discharge limits.

II. What are the trends?

Minnesota, which has 16 ethanol plants producing alcohol fuel from corn and one in Melrose that makes it from cheese byproducts, has had an ethanol industry since 1986.⁵ It also has four biodiesel plants.

Last year, the Minnesota ethanol plants produced an estimated 550 million gallons of ethanol, about 11 percent of total U.S. production.⁶ The Minnesota plants consumed about 200 million bushels of corn, 15 percent of the state's corn crop. In 2008, the ethanol industry in the state is projected to use more than one-fourth of a somewhat larger corn crop. About half last year's ethanol production was burned in Minnesota cars and trucks; half was exported to other states.

The state Department of Natural Resources estimates that Minnesota's ethanol industry used 2.3 billion gallons of groundwater in 2006. That is about 1 percent of total groundwater usage, and 11 percent of all groundwater used for industrial processing.⁷

Across the country, there are 134 ethanol plants currently producing fuel, and 77 under construction, according to the Renewable Fuels Association, a trade group. The industry, which produced 4.9 billion gallons of ethanol last year, will have a total capacity of 7.2 billion by the end of this year, according to the association.

In both Minnesota and the U.S., the ethanol industry has been spurred by direct subsidies – 51 cents a gallon at the federal level for ethanol that is blended into gasoline by fuel distributors -- and by federal requirements encouraging the substitution of ethanol for some chemical additives formerly put into gasoline to fight air pollution. Minnesota also is still paying a direct subsidy of up to 20 cents per gallon of ethanol to owners of eight ethanol plants built before 1998.

Since 1997, Minnesota has required that all gasoline sold in the state contain 7.7 percent ethanol; the requirement was raised to 10 percent in 2005.⁸ Production of ethanol in the state has increased 450 percent since 1997. In 2005, the Legislature and Gov. Tim Pawlenty enacted legislation that will require a 20 percent mix of ethanol in gasoline by 2013 -- unless ethanol sold for 85 percent alcohol E85 fuel has already accounted for 20 percent of total gasoline sales by then.

U.S. corn farmers and the ethanol industry have lobbied heavily to promote ethanol and maintain the federal subsidy.

Over recent years, especially since the Sept. 11, 2001, terrorist attacks, U.S. policy makers, including President Bush, often have promoted ethanol as an alternative to dependence on foreign oil imports. In his State of the Union speech last January, Bush called for the production of 35 billion gallons of ethanol a year by 2017. Reaching that goal would equal 15 percent of

U.S. liquid transportation fuel needs in 2017, and it would represent a seven-fold increase from last year's ethanol production.

A 2005 federal energy bill already had set a national mandate requiring a doubling of ethanol use in gasoline between 2004 and 2012.⁹

The 2005 federal legislation, soaring world oil prices and the existing federal subsidy combined to create the ethanol boom. There has been a "dramatic expansion in corn ethanol production and high interest in further expansion over the next decade," the National Research Council said. The surge of interest in ethanol spawned by record prices in 2006 prompted:

- Plans by ethanol companies to significantly expand production capacity. Total U.S. capacity was 4.3 billion gallons in January of 2006, was 5.5 billion gallons in January of 2007, and is projected at 7.2 billion gallons in late 2007, according to the Renewable Fuels Association.
- Big increases in stock prices for ethanol producers and other companies in the industry.
- A significant increase in prices paid to farmers for their corn. In October, the average price paid in Minnesota was \$3.15 a bushel, up 34 percent from a year earlier.¹⁰
- An increase both in Minnesota and across the country in the amount of land planted in corn. Nationally, corn plantings increased this year by 15 million acres, or 20 percent, over 2006. Minnesota farmers reported that they planted 8.4 million acres in corn this year, up 15 percent from last year.¹¹

But, over recent months, some of glow from the ethanol boom has faded and investors, who once were pouring money into the ethanol industry, are viewing corn-based ethanol more skeptically. Transportation bottlenecks contributed to a glut of unsold ethanol that depressed prices. Ethanol is corrosive and is shipped by rail, truck or barge, rather than by pipeline. In September and October, both the New York Times¹² and the Wall Street Journal¹³ published articles citing a 30 percent decrease, since May, in the price of ethanol and a big drop in the value of ethanol stocks. "Ethanol Boom Runs Out Of Gas," was the Wall Street Journal's headline.

Even when the boom was at its hottest, many critics of corn-based ethanol argued corn is a poor source of motor fuel, requiring nearly as much energy to grow and distill as it eventually yields. Those critics argued that the big build-up of a corn-based ethanol industry could hinder the future commercial development of more efficient processes for producing so-called "cellulosic" alcohol from prairie grasses, willows, poplars and other plants.

Critics of corn-based ethanol also began to question the ethanol industry's demands on ground water supplies in some areas. The National Research Council report, funded in part by the St. Paul-based McKnight Foundation was the most comprehensive examination of ethanol and the threats the industry poses to water. The report, while it did not examine biodiesel in great

detail, looked considerably more favorably on soybean-derived biodiesel compared to corn-based ethanol. The report said:

“Per unit of energy gained, biodiesel requires just 2 percent of the N (nitrogen) and 8 percent of the P (Phosphorus) needed for corn ethanol. Pesticide use differs similarly.”

Central conclusions of the National Research Council report included:

“Currently biofuels are a marginal additional stress on water supplies at the regional to local scale. However, significant acceleration of biofuels production could cause much greater water quantity problems depending on where the crops are grown....

“If projected future increases in the use of corn for ethanol production do occur, the increase in harm to water quality would be considerable... “

III. Why is this issue important to address?

The U.S. must reduce its dependence on foreign oil. Conservation can help immensely.¹⁴ But alternative liquid fuels almost certainly will be a major part of the national effort. The National Research Council report spells out the threat the current corn-based ethanol industry poses to water quality and – in some areas – to water supplies.

IV. What factors contribute to this issue?

There are many factors: technical, economic, political. So far, no one has demonstrated a commercially viable means of producing ethanol from prairie grasses and other organisms that research indicates would be far more efficient than corn as a source of alcohol for fuel. Making ethanol from other non-corn sources, while it probably would not promote irrigation, would also require water in the production process.¹⁵

The country is rapidly developing an infrastructure to produce corn-based ethanol. Farmers and the industry will exert political pressure to protect their investment. Farm-state politicians and candidates who want to fare well in presidential caucuses in Iowa have a strong political incentive to support maintenance and expansion of the current ethanol industry.

V. What is the regulatory oversight?

In Minnesota, the state Department of Natural Resources regulates water usage from either surface or sub-surface waters. To get a permit to use ground water, the company proposing the plant routinely is required to pump water from the ground for up to 30 days at the rate at which it expects to consume water. Then nearby wells and surface waters are tested for evidence that the aquifer could not sustain the pumping.

The Pollution Control Agency regulates, through a permitting process, the discharge into surface waters of ground water used to cool the ethanol plants. Usually only cooling water is discharged; water used in the alcohol distilling process is recycled repeatedly.

The PCA also regulates water runoff from plant sites, above-ground storage tanks at the plants and air pollution emitted by the plants.

VI. Is this an issue for other nongovernmental groups?

In Minnesota, the Institute for Local Self-Reliance is a promoter of ethanol. The Center for Environmental Advocacy views ethanol skeptically.

VII. Who are the primary stakeholders?

Farmers – those who grow corn and, especially, those who are investors in co-op ethanol plants. In Minnesota, there are about 5,000 such farmer members of co-ops. Big ethanol producers, like Archer Daniels Midland Co. Investors in the current ethanol industries. The auto industry, which is gearing up to produce many more vehicles capable of operating on a mix of fuel containing 85 percent ethanol. The auto industry might oppose a massive switch to diesel vehicles capable of using more-efficient soybean-based biofuel.

Everyone who eats, both in this country and around the world, has a stake in the ethanol industry because it converts food into fuel.

VIII. What is working?

There is intense research aimed at developing commercial alternatives to corn-based ethanol. The National Research Council report highlighted the water-quality implications of corn-based fuel.

On Nov. 30, 2007, negotiators for the U.S. House and Senate took a big step toward conservation when they agreed to demand a 40 percent improvement in the fuel efficiency of cars and light trucks.

IX. What is necessary to see real gains?

Technology breakthroughs that would:

- Yield a domestically produced motor fuel alternative – perhaps hydrogen, perhaps electricity -- to both gasoline and ethanol.
- Allow much more crop-based ethanol or bio-diesel fuel to be produced on currently available farmland, without big increases in fertilizers, pesticides and herbicides.
- Allow ethanol to be produced by other means or on marginal land that would not have to be intensely cultivated or fertilized.

X. For more information

The National Research Council report. www.nap.edu/catalog/12039.html.

Renewable Fuels Association, an ethanol industry trade group. www.ethanolrfa.org.

Minnesota Department of Agriculture. www.mda.state.mn.us.

¹ www.nap.edu/catalog/12039.html The National Research Council is part of the National Academies, a government-sponsored institution that “advises the nation on science, engineering and medicine.” The report and the July 2007 colloquium in Washington, D.C., that led to its production were sponsored, in part, by the St. Paul-based McKnight Foundation. .

² The biodiesel industry, which makes fuel from waste fats and other oil plants, as well as soybeans, claims a production capacity of 1.85 billion gallons a year, about one-fourth the ethanol capacity. www.biodiesel.org and www.ethanolrfa.org.

³ Five percent of the national corn crop was irrigated in 2002; two percent of the Minnesota crop was. National Agricultural Statistics Service of the U.S. Department of Agriculture. www.nass.usda.gov.

⁴ “Water Use by Ethanol Plants: Potential Challenges,” a research report by the Minneapolis-based Institute for Agriculture and Trade Policy. www.iatp.org.

⁵ Minnesota Department of Agriculture.

⁶ Minnesota Department of Agriculture and Renewable Fuels Association.

⁷ Sean Hunt of the DNR.

⁸ Subsidy data are from Ralph Groschen of the Minnesota Department of Agriculture.

⁹ The New York Times. Sept. 30, 2007.

¹⁰ National Agricultural Statistics Service of the U.S Department of Agriculture.

¹¹ National Agricultural Statistics Service. www.nass.usda.gov.

¹² New York Times. Sept. 30, 2007.

¹³ Wall Street Journal. Oct. 1, 2007.

¹⁴ On Nov. 30, 2007, negotiators for the U.S. House and Senate reached tentative agreement on energy legislation that would require American car and truck manufacturers to improve the fuel efficiency of their vehicles by 40 percent. The New York Times.

¹⁵ The National Research Council quoted an estimate that water usage in a commercially viable plant producing ethanol from cellulose would be 2 to 6 gallons per gallon of ethanol produced. That’s more water than it takes to refine a gallon of gasoline, and it’s about the same as for corn-based ethanol.