Lower Arkansas River Basin High Priority Issue
Bioenergy and Water
January 2009

Issue

Renewable fuel production is a growing issue in the Lower Arkansas basin, where increased biofuel production provides economic opportunity. As new biofuel facilities are sited and changes are made to the basin's cropping patterns, more evaluation is needed of the impacts from the increased demand on both water supply and water quality.

Description

Gas and oil production is the second largest industry in Kansas and is very important to the Lower Arkansas basin's economy. The growing industrial contribution to the basin's economy is also related to bioenergy production, primarily ethanol. As of December 2008 (Figure 1), three ethanol plants are located in the basin in Pratt (idled), Sedgwick and Rice counties. An additional ethanol plant is under construction in Sedgwick county. Two biodiesel plants are permitted for construction in Kiowa and Stafford counties and one is under construction Sedgwick County.

Water Quantity

Ethanol production, like many industrial and agricultural practices, involves a consumptive use of water. A 50-million gallon per year (MGY) ethanol plant uses about 200 MGY of water (or about 550,000 gallons per day), primarily from evaporation during cooling and wastewater discharge. Ethanol production technology uses water more efficiently; plants today use about 50% less water than 10 to 15 years ago. It currently takes roughly three to four gallons of water to produce one gallon of ethanol. Under Kansas law for appropriating water, ethanol plants, as any industry, must purchase water from a rural water district or municipality or acquire a water right.

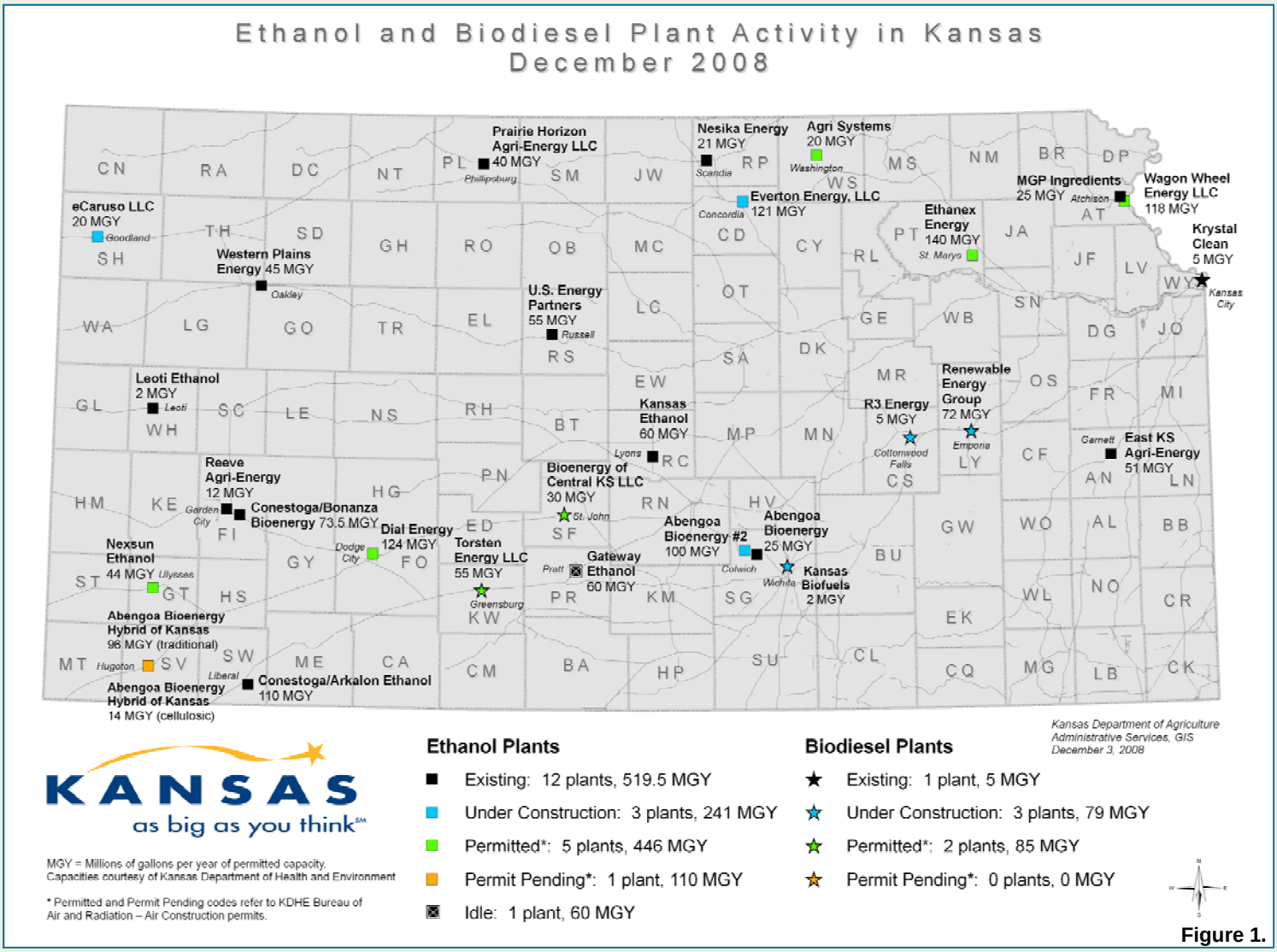

Figure 1.

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Parts of the basin are closed to new water appropriations; in closed areas, any new venture must purchase an existing water right, and any change in use of that appropriation must be approved by the Chief Engineer of the Division of Water Resources to ensure that the net consumptive use does not increase. Nonetheless, some people have raised concerns that increased corn production, a water-intensive crop, for ethanol may cause additional declines over time.[2, 3]

Most U.S. ethanol is made from corn, but it can also be produced from other feedstocks such as grain sorghum, wheat, barley or potatoes. In Kansas, more than half of the ethanol produced comes from grain sorghum, with most facilities using corn and sorghum interchangeably.[2] This new demand for corn, and the new opportunities for value-added processing and distiller's grains for cattle feed in rural communities, has created a significant economic development opportunity in Kansas and throughout the Lower Arkansas basin. However, the potential changes to the basin's cropping patterns, specifically increasing the number of irrigated corn acres, may negatively impact the aquifer and stream conditions.

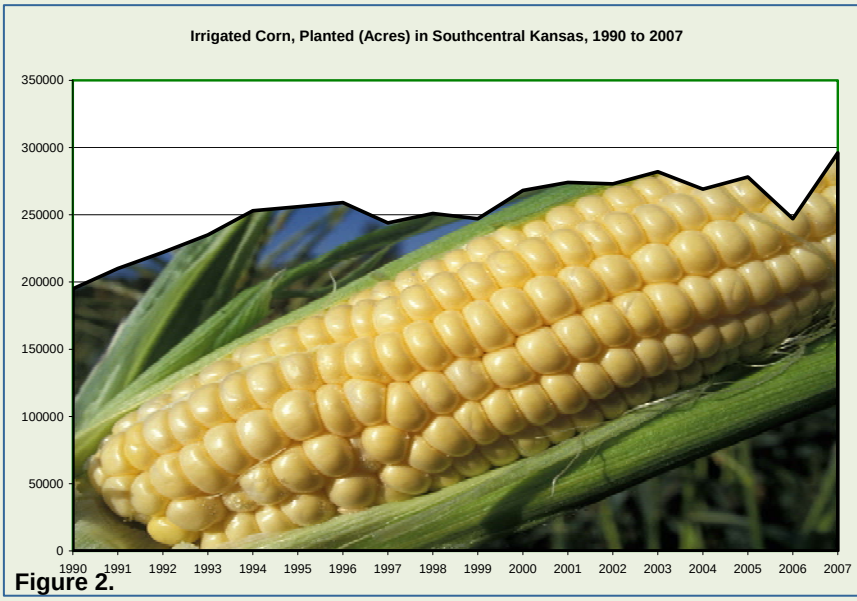

Figure 2.

According to the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), the number of irrigated corn acres in southwest Kansas grew from 195,000 acres in 1990 to 296,000 in 2007. Improved agronomic practices and crop genetics have led to higher corn yields. In south central Kansas, while there was a 26% increase in irrigated corn acres from 1993 to 2003, there was a 67% increase in irrigated corn production.[10] Recent years reflect the highest recorded irrigated corn acres for this region (Figure 2).[6] In 2006, approximately 16% of Kansas corn and sorghum crops were used for ethanol production, up 13% from 2000. Corn production in Kansas may be slowing down. According to NASS, producers intended to plant eight percent fewer corn acres in 2008, as a result of multiple factors including crop rotation considerations and high input costs. In 2008, Kansas was expected to plant their largest soybean crops in history.[5]

Water Quality

Wastewater from ethanol plants is regulated by the Kansas Department of Health and Environment (KDHE), which administers both the federal National Pollution Discharge Elimination System (NPDES) permits and Kansas Water Pollution Control permits. In most instances, KDHE issues the state-level permit, which requires ethanol plants to use the wastewater for beneficial land applications rather than simply discharging into streams and rivers.

A rise in the number of corn acres may also impact the basin's water quality through increased fertilizer application and soil erosion. Corn has the greatest application rates of both fertilizer and pesticides per acre, higher than for soybeans and mixed-species grassland biomass. The switch from other crops or noncrop plants to corn may lead to higher application rates of highly soluble nitrogen. Harvested row crops, such as corn, have a higher potential for soil erosion than grasses or perennial crops. The potential water quality impact of an increased demand for corn may be mitigated through Best Management Practices (BMPs), especially those addressing soil erosion and herbicide applications.

The restoration of watersheds with impaired water quality and the protection of watersheds above public water supply reservoirs and ground water sources used for drinking water supplies are also a high priority issue in the Lower Arkansas Basin.

Biodiesel

Biodiesel is produced using oils extracted from crops, animal fat or waste vegetable oil using a chemical process called transesterification. Most U.S. biodiesel is produced from soybean oil, although other vegetable oils such as canola, corn, cottonseed, flax seed, sunflower, or peanut oil can be used. As of December 2008, two biodiesel facilities, are permitted for the Lower Arkansas basin; one in St. John and one in Greensburg (Figure 1).

Biodiesel production uses roughly three gallons of water per gallon of fuel, about a gallon of which is consumptive use. Wastewater from biodiesel plants, which may contain high amounts of oxygen, grease and oils, is regulated by the Kansas Department of Health and Environment (KDHE).

Cellulosic Ethanol

Cellulosic ethanol uses lignocellulose, the main structural material in any plant, as a feedstock. Cellulosic feedstocks require an extra step to break down the lignocellulose into fermentable starch, thus increasing production costs. The bulkier cellulosic feedstocks are also more costly to harvest, transport and store. Processing of cellulosic materials would require more water than corn, perhaps twice as much, as the feedstock is dry. Research on cellulosic feedstocks such as switchgrass, wood chips and corn stover is ongoing. The U.S. Department of Energy (DOE) has set 2012 as a target to achieve technological advances to make cellulosic ethanol cost competitive with corn ethanol. While not located in the Lower Arkansas basin, in 2007, Abengoa Bioenergy, a Spanish energy company, announced that Hugoton, Kansas would be the site of the nation's first cellulosic ethanol plant. In conjunction with cellulosic ethanol research, some researchers are investigating the use of perennial polyculture crop systems for cellulosic feedstocks.

Production of cellulosic ethanol may have greater positive environmental impacts than grain-based ethanol such as reduced greenhouse gas emissions, decreased fertilizer application, and less reliance on water intensive crops.

Corn Research and Varieties

Breeding of corn hybrids that maximize yield for ethanol production while reducing additional strains on water supplies has been a focus of much research by universities and corn breeding companies. Drought tolerant hybrids, specifically transgenic drought resistant corn, are especially important in areas of western Kansas where rainfall averages fewer than 16 inches per year. In addition to drought tolerant varieties, industries are identifying corn varieties that produce higher yield and more ethanol per acre. High total fermentable ethanol corn hybrids provide higher levels of fermentable starch, consisting of the sum of all starches and simple sugars that ferment during the typical dry grind process.[4,7]

Recommended Actions

1. Coordinate, where applicable, the development, implementation and public input process between the *Kansas Water Plan* and Kansas energy policy.
2. Maintain regulatory oversight by state and local government on the siting of ethanol and biodiesel plants, with special emphasis on water supply availability.
3. Look for increased water recycling opportunities within the biofuel facilities.
4. Promote research for less water-dependent corn varieties and improved irrigation scheduling that maintains or increases crop yield without increasing water use.
5. Promote research and pilot projects for viable, commercial cellulosic ethanol production and other biofuels that are less dependent on water intensive crop production.
6. Increase corn water use efficiency (amount of grain produced per inch of water) through research and extension efforts. Educational emphasis should be placed on utilization of irrigation scheduling tools such as KanSched and the Mobile Irrigation Lab (MIL).
7. Evaluate the biofuel facility watershed and watersheds of input crops to identify potentially environmentally sensitive areas. Target programs such as stream buffers, grass filters, BMPs, etc., to mitigate environmental impacts.
8. Provide education and/or incentives to landowners of marginal lands that have expiring Conservation Reserve Program contracts that can not be renewed to stay in a conservation planting with special consideration to acres that could return to irrigation. If coming out of CRP, encourage landowners to explore all options for conservation.

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Resources

1. Kansas Corn Growers Association. April 2008. Kansas Corn and Water Quality. http://www.ksgrains.com/corn/water.html

2. Kansas Energy Council. December 2007. Kansas Energy Report 2008.

3. Kansas Energy Council. January 2007. Kansas Energy Report 2007. Kansas Energy Chart Book.

4. Monsanto Industry Webpage, accessed on May 6, 2008. http://monsanto.com/products/seeds_traits/corn.asp

5. National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Department of Agriculture. March 2008. rospective Plantings.

6. National Agricultural Statistics Service (NASS), Agricultural Statistics Board, U.S. Dept. of Agriculture. March 2008. Crops and Plants National Statistics.

7. Pioneer Industry Webpage, accessed on May 6, 2008. www.pioneer.com

8. Science Daily. Retrieved April 4, 2008. http://www.sciencedaily.com/releases/2007/10/071010120538.htm

9. U.S. Department of Energy. http://www.doe.gov/energysources/bioenergy.htm

10. White, Jere, Executive Director, Kansas Corn Growers, August 13, 2008, written communication.