



The nation's newfound thirst for corn-based ethanol is causing huge ripple effects likely to raise not just the price of cornflakes, bacon, and eggs, but also of bourbon, farmland, and soybeans.

Corn Power

■ By Margaret Kriz



This spring, American farmers are planting corn—a phenomenal amount of it—and hoping to harvest gold. Lured by prices that have doubled in less than a year, farmers intend to plant 90.5 million acres of corn this year. That's 12 million more acres than in 2006—a 15 percent hike—and more corn than has been planted in the United States since World War II, according to the Agriculture Department's March 30 crop report. Fueling this sudden interest is the unprecedented expansion of the nation's corn-based ethanol industry to lessen the nation's dependence on foreign oil. "This is really a stunning development in agriculture," notes Keith Collins, the USDA's chief economist.

■ **PIT STOPS**
Once thought of primarily as a breakfast fuel, corn now yields 8.8 billion gallons of ethanol.

■ PRAIRIE POTHOLES

The wetlands where 70 percent of the nation's ducks are hatched are rapidly being drained by corn growers.



Ethanol's power to move agriculture markets is causing widespread ripple effects—potentially raising not just the price of cornflakes, corn-sweetened soft drinks, and steak, and bacon and eggs from corn-fed livestock, but also the price of bourbon, farmland, and crops that corn is pushing off the fields. And the ripples extend well beyond the cost of commodities.

In the Great Plains and the Midwest, for example, pond-studded grasslands are disappearing rapidly as farmers rush to cash in on corn. The area, known as the Prairie Pothole Region, which stretches from Iowa, across the Dakotas, into northern Montana, and up into Canada, is where 70 percent of the nation's ducks are hatched, according to Ducks Unlimited, a conservation and advocacy group. As those prairies are plowed and wetlands are drained, the

nation's population of mallards, pintails, and blue-winged teal will dwindle, conservationists fear.

In South Dakota alone in the past five years, farmers have grown crops on 300,000 acres that had never before been farmed. By 2010, almost half of the state's Conservation Reserve Program land—acreage that farmers have voluntarily set aside for erosion control and wildlife habitat, in exchange for federal subsidies—is likely to be sprouting corn or other crops, according to the Agriculture Department.

"We've been aware of the forward creep of corn and soybeans for several years," said Bart James, a Ducks Unlimited governmental-affairs representative. "If ethanol production is not done in a way that protects wildlife needs, it could be detrimental for the waterfowl and hunting." What's bad for

\$3.60

Projected average price of a bushel of corn this year.

ducks is bad for duck hunters—and the gunmakers, outdoor-supply stores, and coffee shops that rely on their business. Waterfowl hunting is a \$1 billion-a-year industry, according to the Interior Department's Fish and Wildlife Service.

Ducks and their hunters are feeling the effects, because the demand for ethanol—which in this country is still almost entirely a corn-based fuel—is skyrocketing. In 1980, two years after the federal government began subsidizing ethanol to lessen U.S. dependence on foreign oil, the fledgling industry produced a mere 175 million gallons of the alternative liquid fuel. By 2000, U.S. ethanol plants made 1.6 billion gallons. This year, Agriculture officials expect ethanol production to climb to 8.8 billion gallons. By 2010, according to USDA projections, ethanol producers will be devouring one-third of the nation's corn crop. And by 2016, they will be churning out at least 12 billion gallons of the fuel. Jumping on the ethanol bandwagon, farm cooperatives and, increasingly, Wall Street investors have built 115 ethanol plants since the late 1970s. Ground has been broken for 79 more, according to the Renewable Fuels Association.

The price of corn has followed the boom in ethanol production. For almost a decade, corn hovered around \$2 a bushel. But last year, as the ethanol industry shifted into high gear, corn briefly hit \$4.40 a bushel. USDA's Collins predicts that a bushel of corn will average a bit less than \$3.60 this year, "still an all-time record high."

Rattling the Food Chain

Ethanol-industry officials boast that the biofuels production plants popping up across the Midwest are breathing new life into fading farm towns. "We are revitalizing rural America," said Bob Dineen, president of the Renewable Fuels Association. "I see it every time I go out to a new ethanol plant and I pull up to a small town in Nebraska that hasn't seen a new business in 25 years," he said. "Suddenly they've got an economic engine that's going to drive \$160 million in economic activity to that area."

USDA researchers have just begun to study the ethanol in-

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dustry's effects on rural communities. "A lot of plants seem to be locating in counties that have a history of population loss, many of them going back a couple of generations," said John Cromartie, a population specialist with the USDA Economic Research Service. "The most interesting question is whether the industry is having an impact in stemming some of that migration."

One economic indicator is clear: In 2006, farmland prices jumped 9

percent in Midwestern corn states, according to a report by the Federal Reserve Bank of Chicago. The cost of good quality farmland in Iowa—prime ethanol territory—leaped 13 percent. The report attributed the land-value hikes of recent years, described as "the strongest stretch of gains since the 1970s," to increased ethanol production.

But while corn growers are taking ethanol checks to the bank, other sectors of American society are beginning to experience an economic backlash. Farmers who raise cattle, hogs, or poultry, for example, are paying higher prices to fatten their animals with corn. In 2006, about half of the corn grown in the United States ended up as animal feed. Gregg Doud, chief economist of the National Cattlemen's Beef Association, said that when the price of corn goes up \$1 per bushel, the cost of feeding a herd of cattle jumps \$121 per animal. Nebraska hog farmer Joy Philippi, past president of the National Pork Producers Council, is feeling the same pinch. "Basically, on a pig, instead of \$35 corn costs into the animal before it's harvested, it ends up being \$65," she said. "That's a big difference."

Hog producers are especially worried that feed prices could skyrocket this summer if a drought hits the corn states, Philippi said. "If we have a short crop, you're going to see massive changes in the countryside," she predicted. "We've seen liquidations in the cattle industry because of drought and feed availability, and it may not be a lot different for us."

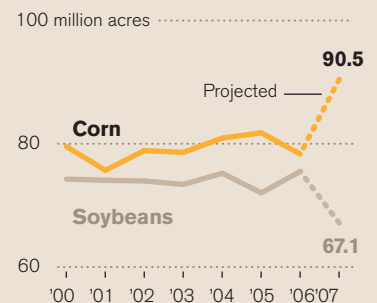
Even without a drought, hog growers would have to take 15 percent fewer animals to market this year to drive up wholesale prices enough to recover today's higher expenses, according to a study by Iowa State University's Center for Agricultural and

■ Fueling Growth



U.S. farmers are expected to plant more corn and less of some other crops such as soybeans this year because of the growth of the ethanol industry. Government projections show an expanding national supply, with ever greater amounts being used in ethanol production.

Crops planted



■ Prime Consumers



PHOTOS L TO R: GETTY IMAGES/RANDI SIMONS; PHOTOGRAPHER SHOWCASE/MICHAEL VENTURA; AP/ISAAC BREKREN

Half the U.S. corn crop ends up as animal feed. And a \$1 jump in the price of a bushel of corn raises the lifetime cost of feeding a head of cattle by \$121.

Rural Development. Some chicken farmers are already recouping their losses by bringing fewer animals to market. In early April, chicken producer Pilgrim's Pride confirmed that it will cut its poultry production by 5 percent this year; the company blamed high feed prices for its decision.

The March 30 crop report, however, predicted that plenty of corn will be available this fall, easing some of the meat industry's concerns. The USDA's Collins conceded that in the long run, higher corn prices will translate into higher meat prices at the supermarket. "Input prices do get reflected in food prices eventually," he said. "Meat production will slow down a bit, and that results in higher retail meat prices. I don't see it [happening] in 2007," he said. "But if ethanol continues to expand—

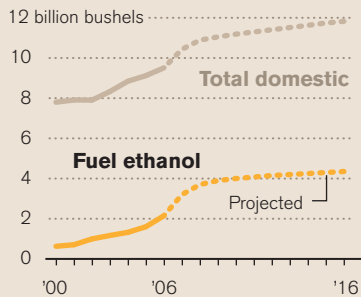
and I think it will—we'll see higher meat prices than we would have otherwise in the 2008 to 2010 period."

The rush to plant corn is already squeezing out other row crops. The majority of this year's new corn acres will be on land previously devoted to soybeans and cotton—commodities that were in oversupply last year. But farmers who traditionally have grown the nation's small specialty crops—a broad category that encompasses many fruits and vegetables, such as green beans, cucumbers, and tomatoes—are being lured away by the potential of big paychecks for growing corn. The most dramatic shift is among farmers who typically plant peas and lentils. The USDA estimates that, nationwide, 20 percent of those acres will instead be planted in corn this year.

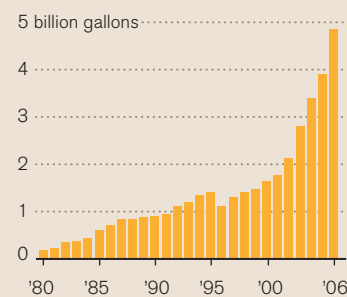
The tide is evident in Michigan, which is second only to California in crop diversity, according to Jim Byrum, president of the Michigan Agri-Business Association. "We are seeing some substantial moves of acreage away from our specialty crops," he said. The state's dry bean crop, for example, is shrinking this year as more growers plant corn. Michigan is the second-largest producer of the nation's dry beans, including black, kidney, navy, and pinto beans. Last year, the state's farmers planted 230,000 acres of dry beans. This year, Byrum said, that number is expected to drop to 190,000.

One factor slowing the rush to plant corn in Michigan is the recent bid-up in the price of dry beans in the commodity

Corn supply and use



Fuel ethanol production



SOURCES: Agriculture Department; Renewable Fuels Association

GETTY IMAGES/J.D. POOLER

■ The Other Liquid



AP/WIDEWORLD/PHOTO BY JEFFREY M. SMITH

For decades, corn has been one of the nation's most popular sweeteners and has replaced more-traditional sugars in many soft drinks and other processed foods.

markets. As a result, according to Byrum, the Michigan dry beans harvested this fall will be worth 50 percent more than those picked in 2006.

Food producers are also likely to pay more for healthier cooking oils such as sunflower and canola, according to Cal Dooley, president of the recently merged Grocery Manufacturers Association/Food Products Association. "We're having difficulty getting adequate supplies of those commodities because farmers are choosing to plant more corn," he said.

Dooley, a former Democratic congressman from California, predicted that grocery shoppers will soon feel the impact of such shortages. "You're seeing these prices just beginning to work their way through the supply chain," he said. "You're going to see the increases be more dramatic in the next six months to a year."

Some industry experts warn that increased ethanol production could raise world food prices and slash American corn exports. In 2006, the United States exported 19 percent of its corn crop. At a March USDA forum, Gregory Page, president and chief operating officer of agricultural giant Cargill, cautioned that higher food costs could have dramatically negative consequences for the world's developing nations. "What price are we willing to make the world's poor pay for food?" he asked. Cargill is one of the largest U.S. investors in ethanol and is the nation's second-biggest beef producer.

A recent University of Minnesota study predicted that the U.S. ethanol boom

could worsen world hunger. If increasing demand for corn inflates global food prices, "1.2 billion people could be chronically hungry by 2025—600 million more than previously predicted," according to the study by economists C. Ford Runge and Benjamin Senauer.

Meanwhile, U.S. environmental activists have a separate set of concerns. Environmental groups plan to file suit to prevent the Bush administration from relaxing air-pollution rules for ethanol plants. Pushed by farm-state lawmakers, the Environmental Protection Agency is expected to issue a regulation later this month that would exempt ethanol facilities from the strict pollution limits that apply to chemical makers. Environmentalists also worry that expanding ethanol production in the Western states will divert dwindling water supplies to corn irrigation and exacerbate the nation's water-pollution problems.

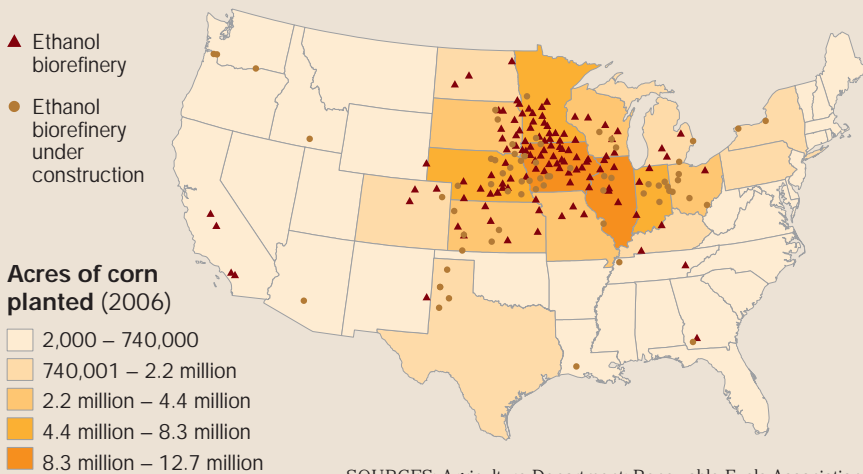
Environmental advocates note that as farmers grow more corn, they'll use more nitrogen-based fertilizer. Some of that nitrogen will be washed into streams

that feed into the Mississippi River and eventually flush into the Gulf of Mexico. Nitrogen runoff has already created a "dead zone" the size of New Jersey in the gulf. The dead zone's waters are so deprived of oxygen that sea creatures flee—and those that cannot leave die.

"We know this [extra corn production] is a problem, but unfortunately it's hard to prove a direct causal link until the hypoxia [oxygen deficiency] shows up," noted Liz Marshall, a senior economist at the World Resources Institute.

■ Corn Country

Every state except Alaska and Hawaii planted at least some corn in 2006, with Iowa and Illinois leading the way with 12.7 million and 11.6 million acres, respectively.



SOURCES: Agriculture Department; Renewable Fuels Association

“By that point, the problems will have already occurred.”

Conservationists also worry that today’s attractive corn prices are enticing farmers to take land out of the federal Conservation Reserve Program. In early March, farmers opted to move 4.6 million acres of the nation’s reserve program lands back into production over the next three years. Some 37 million acres, including land along streambeds or in other difficult-to-farm places, remain in the program. James of Ducks Unlimited said that his group futilely tried to discourage South Dakota landowners from accepting offers of up to \$120 per acre to allow farming on their lands. The Conservation Reserve Program offers a stipend of only \$30 an acre. The government needs to increase farmers’ incentives to leave land undisturbed, he said.

Modern-Day Moonshine

Why is corn so popular?

“It’s the cheapest, the most abundant feedstock that gets us food and fuel,” explained Jim McMillan, principal engineer at the National Bioenergy Center at the Energy Department’s National Renewable Energy Laboratory in Golden, Colo.

“Seventy-five percent of the mass of corn is starch,” he said. “And what is starch? It’s a form of sugar. If you want inexpensive sugar, corn is where you go.” Corn is used to make products from breakfast cereal to livestock feed. Corn sweeteners are in ketchup, soft drinks, yogurt, and a wide variety of other processed foods.

Turning corn into ethanol is nothing new. Ethanol is essentially moonshine, made by fermenting corn sugars and distilling them into alcohol. Henry Ford’s first automobile ran on ethanol. During World War II, U.S. producers mixed ethanol with vehicle fuels to extend the nation’s gasoline supplies. In the 1970s, the government renewed its interest in ethanol as a transportation fuel during the OPEC oil embargo, which cut off oil shipments to the United States and sent prices skyward. But that experiment ended when exporting nations lifted the embargo and gasoline prices collapsed.

Over the years, small amounts of ethanol—up to 10 percent—have been added to gasoline in parts of the United States to make automobile exhaust cleaner. Today, almost half of the gasoline sold domestically contains some ethanol. Studies are under way to determine whether conventional car engines can safely burn a gasoline mixture that is more than 10 percent ethanol. In Brazil, the world’s ethanol capital, nearly all cars are built to run on fuel that is 25 percent ethanol.

Detroit is already producing flexible-fuel vehicles that can operate on either conventional gasoline or E85 fuel, which is 85 percent ethanol and 15 percent gasoline. Five million flexible-fuel cars are on U.S. roadways today, primarily because auto companies receive a credit for each flexible-fuel car or truck they sell. Those credits help the auto manufacturers meet federal fuel-economy standards.

■ A Biorefinery



DETTI IMAGES/SCOTT OLSON

Congress and the Bush administration have embraced ethanol as a way to curb America’s appetite for foreign oil, even though ethanol production uses massive amounts of coal and natural gas.

Few drivers actually pump E85 fuel into their gas tanks, however, because only about 1,167 of the nation’s 170,000 gas stations offer that option. Most gas station owners won’t pay to install E85 pumps, said Dineen of the Renewable Fuels Association. “You can’t convince a gasoline marketer to put in an ethanol pump for less than 3 percent of his consumers,” he said, “especially when only a fraction of those even realize they have the [flexible-fuel] vehicles to begin with.”

American automakers are pledging to help reduce U.S. dependence on oil imports by dramatically increasing their production of flexible-fuel cars. (Japanese car manufacturers, by contrast, are focused on producing more hybrid and electric cars.)

For drivers, however, E85 has a significant downside. “Ethanol has about two-thirds the energy content of gasoline,” McMillan explained. “So for a given gallon, in terms of pure energy, you could only go two-thirds as far.” On top of that, the flexible-fuel cars on the U.S. market today are calibrated to accept both conventional fuel and E85. “The engine technology is not optimally tuned to the E85 fuel,” McMillan said. “So they’re a great way to use more biofuels inefficiently.”

The Bush administration and Congress have embraced ethanol as a way to curb America’s ever-increasing demand for foreign oil, even though the process of making ethanol uses massive amounts of coal and natural gas. Many scientists argue, in fact, that the expanded use of corn-based ethanol would not dramatically reduce the nation’s emissions of greenhouse gases. McMillan notes that growing corn requires fertilizer, which is made from natural gas. Ethanol production is an electricity-intensive process. In the Midwest, much of that power is generated by electric plants fueled by coal or natural gas. “As a consequence,” he said, “it’s not very fossil-fuel efficient.”

Compared with gasoline, the total ethanol life-cycle—from the moment the corn kernel is planted until the liquid is



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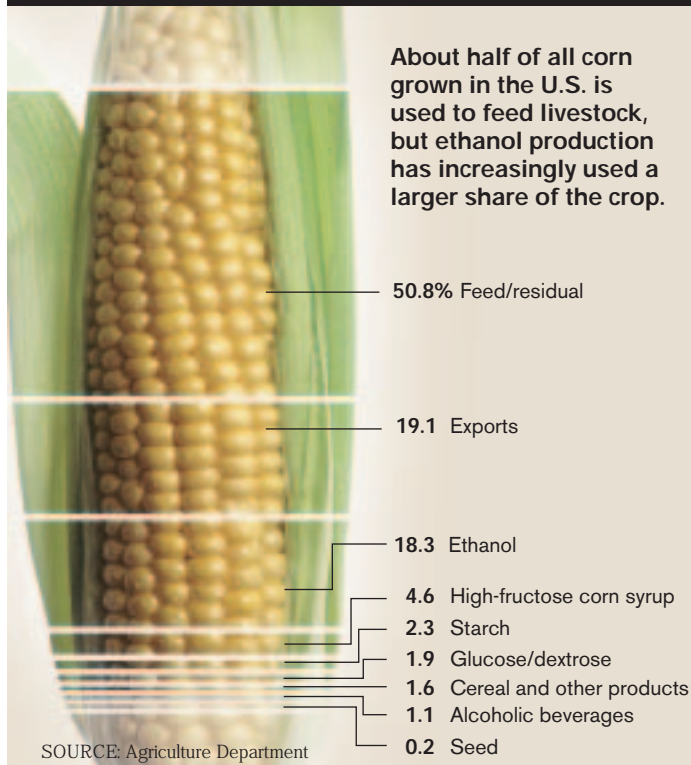
—economists C. Ford Runge and Benjamin Senauer

burned in a car—reduces greenhouse-gas emissions by only 13 percent, according to a University of California (Berkeley) study published in the January 2006 issue of *Science* magazine.

Maxing Out

In his State of the Union address this year, President Bush set a national goal of producing 35 billion gallons of alternative transportation fuel annually by 2017, with an ultimate goal of 60 billion gallons per year by 2030. That's far more than can ever be derived from corn-based ethanol. At most, the United States could eventually produce 15 billion gallons of corn-based fuel each year, according to experts in the corn industry and at the USDA. And reaching even that production level would require significant scientific breakthroughs. Researchers are working to develop varieties of supercorn that are more resistant to drought, disease, and insects, and that could yield more ears per acre. Ethanol facility engineers are also designing techniques to squeeze more ethanol out of each corn kernel.

■ Divvying Up The Crop



To push ethanol production beyond the 15 billion-gallon mark, scientists are investigating methods to transform cellulosic materials, such as high-fiber grasses and agricultural wastes, into car fuel. "If we're going to be more than just a gasoline additive, we have to crack the code to produce ethanol from cellulose," Dineen said.

No commercial cellulosic ethanol plants are yet operating anywhere in the world. But in February, the Energy Department awarded \$385 million in federal funds to six companies seeking to build cellulosic ethanol pilot projects. When fully operational, those plants are expected to produce 130 million gallons of fiber-based ethanol a year. Congress is also discussing a cornucopia of research-and-development subsidies to energize the nascent cellulosic ethanol industry.

Many scientists see cellulosic as the brave new fuel of the future. They envision ethanol facilities that extract the useful sugars out of the cellulose materials and then burn the leftover fiber to power the ethanol manufacturing process. On a life-cycle basis, such fiber-based fuels would emit almost no greenhouse gases. "That would be really moving to the carbohydrate economy," McMillan said. "We would not be dependent on fossil fuels to drive the process."

But while cellulosic ethanol is still in the laboratory, corn-based fuels are already at the gas pump. No matter how quickly the cellulosic ethanol technologies evolve, corn fuels will dominate the biofuels market for the foreseeable future. "We're going to have about 12 to 13 billion gallons of [corn-based ethanol] capacity, regardless of what happens," said Bruce Babcock, director of the Center for Agricultural and Rural Development at Iowa State University. "We're in the middle of a boom. You can't unconstruct these plants."

Proposed additional federal ethanol mandates are likely to spur even higher levels of corn-based ethanol production. The biggest hurdle facing the industry, however, may be the availability of productive farmland. "Except for the Conservation Reserve Program lands, we're at full production right now," said Darrel Good, an agricultural economist at the University of Illinois (Urbana-Champaign). "We don't have land out there just waiting to be planted."

Both the positive and negative effects of the corn ethanol boom will intensify over the next several years as the renewable-fuels market, the auto industry, and the federal government sort out strategies to make the nation both more energy independent and more energy efficient. "A year from now, we're going to be having the same conversation," said USDA economist Collins. "We're going to be anxiously awaiting the intentions of corn farmers and writing stories about what it means for the corn markets. I don't see this going away."

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