

10-1-2023

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### Recommended Citation

Rosensaft, Sydney (2023) "Green Promise or Environmental Threat?: Corn Ethanol's Positive and Negative Effects," *The Synapse: Intercollegiate science magazine*: Vol. 37: Iss. 1, Article 7.  
Available at: <https://digitalcommons.denison.edu/synapse/vol37/iss1/7>

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# Green Promise or Environmental Threat?

## *Corn Ethanol's Positive and Negative Effects*

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Our world is scrambling to find clean energy sources. One explored solution is turning biomass into fuel, specifically corn. Corn ethanol has been an established source of biofuel for decades, with the United States leading the world in biofuel production by producing 47 percent of global output in the last ten years. Initially, this alternative fuel was promoted because it was believed to be more environmentally friendly than fossil fuel choices, producing overall less emissions. The U.S. government passed the Renewable Fuel Standard in 2005, spurring the production and adoption of biofuel. In 2021, the U.S. consumed nearly 14 billion gallons of corn ethanol. However, recent re-evaluations of corn ethanol's life cycle impact show that it is not better than gasoline as a fuel source — and likely much worse.

Ethanol is an alcohol produced from sugars through fermentation processes carried out by yeast. Fuel ethanol is highly concentrated, with water removed and compounds added, rendering the alcohol undrinkable. Fuel ethanol can be used alone or blended with gasoline. Most ethanol in the U.S. is produced from starch-based crops by dry or wet mill processing. Dry-milling grinds corn into flour and ferments it into ethanol using the co-products of distillers' grains and carbon dioxide. Wet-milling first separates the corn's starch, protein, and fiber before processing these components into products such as ethanol. Ethanol production technology can now produce about 2.7 gallons of fuel ethanol per bushel of corn. The processing of corn into ethanol produces co-products that can substitute corn grain and soybean meal in livestock feed, doubling the products of this process.

At first glance, corn ethanol is a clean fuel — better for the environment than traditional gasoline. Corn is biomass and derives its initial energy from the sun, while it can also be regrown relatively quickly (unlike fossil fuels). A study examined how technological advancements will affect the land required to produce corn ethanol. In 2011, 25 percent of acres in the U.S. were used to grow corn for ethanol fuel production. In 15 years, as technology develops, the study predicted that just 13-19 percent of acres will be used. One way this might happen is a fermentation technology that converts both starch and other sugar components, like fibers, into ethanol. This technology increases yield by 2.759-3.078 gallons of ethanol per bushel of processed corn. With such technological advancements, the land needed to produce corn ethanol decreases. Overall, the argument for expanding corn ethanol is that it is clean, corn can be easily regrown, and technological developments will reduce the land required.

The U.S. government was tuned in to the innovative, agriculturally-produced, and renewable fuel sources as their popularity grew and technology developed. In 2005, the government enacted the Renewable Fuel Standard program, which requires a minimum volume of renewable fuels to replace petroleum-based transportation, heating, or jet fuel. The program aimed to replace fuels that emit greenhouse gasses with clean energy sources, promote rural economic development and reduce

U.S. dependence on foreign energy sources by encouraging domestic fuel production. At the time, the U.S. was a net energy importer and relied on other countries for fuel. Part of the Renewable Fuel Standard requirements included the expansion of the use of corn ethanol by up to 15 billion gallons annually. This policy motivated farmers to plant corn for corn ethanol processing. Major agencies in the U.S. — including the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, and the U.S. Geological Survey — all reported rapid cropland expansion. Since 2000, corn ethanol production in the U.S. has increased significantly, from 1.6 to 15 billion gallons. Throughout the last decade, ethanol production has kept corn in high demand, making it the most planted U.S. crop and bringing record profits to leading companies that buy and sell corn.

Unfortunately, using land for this purpose has a cost vastly underestimated by those who encourage corn ethanol production. The extent of domestic land use change is at least equivalent to the change caused by gasoline use — and likely to be up to 24 percent higher. Modern farming releases carbon stored in the soil, especially as farmers scramble to develop their previously untilled areas to boost corn production. One big concern is that farmers have been plowing land previously used for conservation

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purposes. The Conservation Reserve Program is a federal program that pays farmers to keep some of their land uncultivated. After the Renewable Fuel Standard was updated in 2007, however, farmer enrollment in this program decreased substantially as farmers chose to capitalize on high corn prices. The CRP is now at its lowest enrollment in 30 years, which means a lot of carbon previously stored in uncultivated soils has been emitted into the atmosphere.

Farmers also rely on fertilizers to grow corn, introducing pollutants to the land and runoff waters. Since the Renewable Fuel Standard was passed, a study found that nationwide annual fertilizer use surged by three to eight percent, and water pollutants rose by three to five percent — likely due to increased fertilizer use. Downstream of many U.S. farms, in the Gulf of Mexico, an annual dead zone appears because of the increasingly toxic water. In 2021, more than 6,300 square miles of Gulf Coast waters were starved of oxygen, leaving four million acres of fish habitat uninhabitable. This oxygen depletion disrupted fisheries and damaged marine habitats, costing about \$2.4 billion.

With an incentive to grow more corn, farmers have been neglecting other crops like soybeans and wheat. Normally, the rotation of crops is important for the soil to maintain a healthy nutrient balance. However, farmers are skipping rotations and farming corn as a monoculture, where only one crop is planted in an area. Monocultures decrease biodiversity in an area, which can





harm the land long-term and make it unhealthy and unsuitable for agriculture. The lack of soybeans and other crops has also caused their prices to spike by 20 percent, making food more expensive and exacerbating food justice issues. Additionally, the race in the U.S. to produce corn ethanol is in danger of triggering the fuel market rebound effect: when a greater fuel supply is available, an overall rise in fuel consumption occurs. This situation risks Americans becoming dependent on and demanding more of this land-intensive fuel. These factors highlight gaps in previous studies and underscore how the effects of land use changes were underestimated. Instead of feeding growing populations or conserving land, the U.S. uses productive farmland for fuel production.

While studies initially treated increased land use for corn farming as a minor problem, expanding these agricultural practices will deplete farmable land and pollute waters. These factors question the effectiveness of climate change mitigation policies that promote corn ethanol and other biofuels. Although these policies guarantee a market for farmers and ethanol producers, corn ethanol production, as encouraged by the U.S. government,

is costing the American public. We pay more for gas, certain crops have become more expensive, and our taxes are subsidizing crop insurance programs. Iowa farmers receive the most federal subsidies in the country, meaning we are paying farmers to continue expanding harmful corn-growing practices. America is also facing reduced water and air quality, degraded soil, and habitat loss because of corn ethanol expansion. This makes the Renewable Fuel Standard counterproductive.

When the Renewable Fuel Standard became law, the U.S. was a net oil importer, relying on foreign sources for fuel. The U.S. is now a net oil exporter and has less reason to be concerned with energy independence, as it produces most of its own energy domestically. The policy needs to be updated and re-evaluated, as it encourages a fuel that is no better than gasoline. As a climate solution, the Renewable Fuel Standard's encouragement of corn ethanol production has proved counterproductive, especially in the face of more efficient and worthwhile innovative energy technologies. ● ● ●