Fueling ethanol production while protecting water quality

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Grain-based ethanol production has increased dramatically in recent years as the cost and instability of oil has increased. New U.S. government policies require major increases in ethanol production. While future plans call for a viable cellulosic ethanol industry, expanded grain ethanol production will lead to further growth of corn acres in the near term, with unintended negative water quality impacts.

Currently, U.S. grain-based ethanol production is concentrated in the "Corn Belt"; however, several large production plants are under construction or planned near population centers in the eastern U.S.

An interdisciplinary group of scientists evaluated potential impacts of grain- and cellulose-based ethanol on nutrient and animal management as they relate to water quality impacts on U.S. inland and coastal waters, particularly the Northern Gulf of Mexico (Mississippi River Basin discharge). The results of their evaluation were published in the March–April issue of the Journal of Environmental Quality and were also considered in the U.S. EPA Scientific Advisory Board's 2007 Hypoxia Advisory Panel's report.

The group of scientists recommended rigorous implementation of advanced conservation measures to minimize N and P losses from new or more intensively managed corn to partially offset nutrient loss increases. These measures include precision and variable rate applications of fertilizers, inter-seeding corn with cover crops, and inclusion of buffers or riparian filter strips. A viable perennial grass, wood, or waste-based cellulosic ethanol industry could provide water quality benefits and other ecosystem services. Regardless of feedstock, policy and scientific decisions must consider and address unintended consequences of biofuel production on the environment, particularly water quality, to avoid higher, future costs of remediation and ecosystem restoration.

Corn prices nearly doubled between 2005 (about $2.25 a bushel) and 2007 (about $4 per bushel; now about $5.00 per bushel) and there was a 15% increase in U.S. corn acres last year. The scientists projected that much of this increased acreage would come from land in soybeans (50%), the Conservation Reserve Program (25%), and hay and pastures (25%). Recent data indicate that much row crop conversion was from cotton as well as soybeans. This would not impact P loss estimates and could increase N loss. Even with recommended fertilizer and management, corn can be a greater source of N and P loss to water than soybeans, perennials, or hay crops. Most of the corn acreage increase occurred in the Mississippi River Basin, and in this basin, most N and P that leaves fields is delivered to the Gulf.

Dried distiller's grains, a by-product of ethanol production, is being used in animal feeds, particularly for dairy and beef. Dried distiller's grains contain high concentrations of P and may elevate manure P (and N) content, even when less than 20% of the animals' diets. This may erode efforts to reduce ration and manure P and will make government feed management programs more expensive and less attractive to farmers. The use of wet distiller's grains as feed near ethanol facilities avoids the cost of drying the distiller's grains but requires co-location of animal operations, which will concentrate manure production, often far from grain production, making effective manure use as a fertilizer more difficult and expensive.

Cellulosic fuel stocks from perennials such as switchgrass and woody materials also have the potential to produce ethanol. While cellulosic feedstock production, storage, handling and conversion technology still limit production, a viable cellulosic ethanol industry could reduce dependence on grain and provide water quality and other environmental benefits (such as C sequestration and wildlife habitat). For example, switchgrass, a warm-season perennial prairie grass, produces large amounts of biomass for feedstock, loses very little N and P compared to corn, and stores C in its extensive root system.

Source: Soil Science Society of America