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Increase in Ethanol Production From Corn Could Significantly Impact Water Quality

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WASHINGTON — If projected increases in the use of corn for ethanol production occur, the harm to water quality could be considerable, and water supply problems at the regional and local levels could also arise, says a new report from the National Research Council. The committee that wrote the report examined policy options and identified opportunities for new agricultural techniques and technologies to help minimize effects of biofuel production on water resources.

Recent increases in oil prices in conjunction with subsidy policies have led to a dramatic expansion in corn ethanol production and high interest in further expansion over the next decade, says the report. Indeed, because of strong national interest in greater energy independence, in this year's State of the Union address, President Bush called for the production of 35 billion gallons of ethanol by 2017, which would equal about 15 percent of the U.S. liquid transportation fuels.

A National Research Council committee was convened to look at how shifts in the nation's agriculture to include more energy crops, and potentially more crops overall, could affect water management and long-term sustainability of biofuel production. Based on findings presented at a July colloquium, the committee came to several conclusions about biofuel production and identified options for addressing them.

In terms of water quantity, the committee found that agricultural shifts to growing corn and expanding biofuel crops into regions with little agriculture, especially dry areas, could change current irrigation practices and greatly increase pressure on water resources in many parts of the United States. The amount of rainfall and other hydroclimate conditions from region to region causes significant variations in the water requirement for the same crop, the report says. For example, in the Northern and Southern Plains, corn generally uses more water than soybeans and cotton, while the reverse is true in the Pacific and mountain regions of the country. Water demands for drinking, industry, and such uses as hydropower, fish habitat, and recreation could compete with, and in some cases, constrain the use of water for biofuel crops in some regions. Consequently, growing biofuel crops requiring additional irrigation in areas with limited water supplies is a major concern,
the report says.

Even though a large body of information exists for the nation's agricultural water requirements, fundamental knowledge gaps prevent making reliable assessments about the water impacts of future large scale production of feedstocks other than corn, such as

switchgrass and native grasses. In addition, other aspects of crop production for biofuel may not be fully anticipated using the frameworks that exist for food crops. For example, biofuel crops could be irrigated with wastewater that is biologically and chemically unsuitable for use with food crops, or genetically modified crops that are more water efficient could be developed.

The quality of groundwater, rivers, and coastal and offshore waters could be impacted by increased fertilizer and pesticide use for biofuels, the report says. High levels of nitrogen in stream flows are a major cause of low-oxygen or "hypoxic" regions, commonly known as "dead zones," which are lethal for most living creatures and cover broad areas of the Gulf of Mexico, Chesapeake Bay, and other regions. The report notes that there are a number of agricultural practices and technologies that could be employed to reduce nutrient pollution, such as injecting fertilizer below the soil surface, using controlled-release fertilizers that have water-insoluble coatings, and optimizing the amount of fertilizer applied to the land.

A possible metric to gauge the impact of biofuels on water quality could be to compare the amount of fertilizers and pesticides used on various crops, the committee suggested. For example, 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 would likely lead to much higher application rates of highly soluble nitrogen, which could migrate to drinking water wells, rivers, and streams, the committee said. When not removed from water before consumption, high levels of nitrate and nitrite — products of nitrogen fertilizers — could have significant health impacts.

Nutrient and sediment pollution in streams and rivers could also both be attributed to soil erosion. High sedimentation rates carry financial consequences as they increase the cost of often-mandatory dredging for transportation and recreation. The committee observed that erosion might be minimized if future production of biofuels looks to perennial crops, like switchgrass, poplars or willows, or prairie polyculture, which could hold the soil and nutrients in place better than most row crops. The committee also identified other ways that farming could be improved, such as conservation tillage and leaving most or all of the cornstalks and cobs in the field after the grain has been harvested.

For biorefineries, the water consumed for the ethanol production process — although modest compared with the water used growing biofuel crops — could substantially affect local water supplies, the committee concluded. A biorefinery that produces 100 million gallons of ethanol a year would use the equivalent of the water supply for a town of about 5,000 people. Biorefineries could generate intense challenges for local water supplies, depending on where the facilities are located. However, use of water in biorefineries is declining as ethanol producers increasingly incorporate water recycling and develop new methods of converting feedstocks to fuels that increase energy yields while reducing water use, the committee noted.

The study was sponsored by the McKnight Foundation, Energy Foundation, National Science Foundation, U.S. Environmental Protection Agency, and National Research Council Day Fund. The National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council make up the National Academies. They are private, nonprofit institutions that provide science, technology, and health policy advice under a congressional charter. The Research Council is the principal operating agency of

the National Academy of Sciences and the National Academy of Engineering. A committee roster follows.

Copies of Water Implications of Biofuels Production in the United States are available from the National Academies Press; tel. 202-334-3313 or 1-800-624-6242 or on the Internet at http://www.nap.edu. Reporters may obtain a copy from the Office of News and Public Information (contacts listed above).

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