Dead zones in Gulf caused, in part, by farm drainage

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Tile drainage system flowing into a drainage ditch between agricultural fields in east-central Illinois in early spring before the crop has emerged.

(PhysOrg.com) -- The tile drainage systems in upper Mississippi farmlands -- from southwest Minnesota to across Iowa, Illinois, Indiana and Ohio -- are the biggest contributors of nitrogen runoff into the Gulf of Mexico, reports a Cornell/University of Illinois-Urbana study.

Nitrogen runoff has been identified as a major contributor to dead zones in the Gulf, where nitrogen fertilizes algae and causes it to bloom, which in turn, depletes oxygen from the water and suffocates other life forms over thousands of square miles each summer.

Tile drainage has greatly increased yields in fertile soils since the 1800s

where there once were wetlands. The systems consist of burying perforated pipes under the soil and draining them into canals. When such fields are fertilized, more nitrogen runs off into the Mississippi River watershed, according to the study.

"A lot of tile drainage is being installed, but we don't know where and how much," said Laurie Drinkwater, associate professor of horticulture, a co-author of the paper recently published in the Journal of Environmental Quality. Mark David, a biogeochemist at the University of Illinois, is the paper's lead author.

"Given the pivotal role of tile drainage in transporting fertilizer nitrogen from agricultural fields to streams and rivers, we need to consider some form of regulation if we expect to reverse hypoxia in the Gulf of Mexico," Drinkwater added.

To estimate nitrogen inputs and outputs, the researchers constructed a database that included 1977-2006 data on corn, soybeans and other crops, livestock and manure, fertilizer inputs, atmospheric deposition of nitrogen and human populations for 1,768 counties within the entire Mississippi River basin. The database also included nitrate concentrations and their flow into streams and rivers from 153 watersheds where data was available over the same time period.

These data were then entered into a computer model designed to show nitrate yields for every county in the Mississippi River basin. The results revealed that the dominant source of nitrogen loss into the Mississippi came from fertilized cornfields on tile-drained watersheds in the upper Mississippi River basin, along with areas in southeastern Missouri and northeastern Arkansas.

Atmospheric nitrogen and animal manure were not found to have a significant effect on nitrogen yields into the Mississippi, though human

sewage did add small additional nitrogen inputs.

To reduce such runoff, solutions include installing wetlands in areas where tiles drain to biofilter the water and fertilizing fields in the spring instead of the fall. Also, "we know that we are losing nitrogen in the period between cash crops when nothing is growing in the field," said Drinkwater. "If we plant winter cover crops and diversify crop rotations, nitrogen losses could be reduced quite a lot." A 2006 study by Drinkwater's research group found that, on average, cover crops reduced nitrogen leaching by 70 percent.

Drinkwater added that policymakers need to increase incentives that reward environmentally beneficial farming practices. Currently, direct payments to farmers focus on production outcomes and do not sufficiently emphasize environmental stewardship, she added.

The Mississippi River basin covers 40 percent of the continental United States and is the largest producer of corn and soybeans in the world.

Provided by Cornell University