The Source of Mississippi River Phosphorus

Nitrogen and phosphorus pollution in the Mississippi River is cited as the reason for the Gulf of Mexico's hypoxic zone. Simple explanations for the problem have often been cited: too many large animal operations, for instance, or farmers who apply too much fertilizer, which then flows into waterways. New research which used models to examine phosphorus loading from all 1768 counties in the Mississippi River Basin, the true causes aren't so straightforward.

Livestock manure is widespread in many counties, but it shows little relationship to water quality, say researchers at the University of Illinois at Urbana-Champaign and Cornell University in the May-June 2011 issue of the Journal of Environmental Quality.

Crop production areas that load phosphorus into the Mississippi are also places where farmers add less phosphorus to the soil than they remove each year in crop harvests, suggesting that overzealous fertilizer use is not the issue. "*If it were that, it would be easy to solve. But it's not that*," says Mark David, a University of Illinois biogeochemist who led the research. "*It's much more complex. So I think in that sense addressing the problem is harder.*"

Soil erosion and tile drainage are among the contributors of phosphorus to the Mississippi and Gulf of Mexico each year, helping fuel a "dead zone" of oxygen-starved water in the Gulf. In an effort to pinpoint important sources of phosphorus across the entire Mississippi River Basin, David's team calculated the yearly phosphorus inputs and outputs for every county in the basin from 1997 to 2006. After aggregating these and other data within 113 watersheds throughout the Mississippi River Basin, they then estimated the river load of phosphorus from every county between January and June for the same time period.

Counties with intensive row crop agriculture contributed the most phosphorus to rivers. However, these same counties often showed negative phosphorus balances, meaning that phosphorus outputs in crops exceeded inputs by farmers. In other words, farmers in these regions are actually mining stored phosphorus from the soil, rather than putting more into the system, David says. "*But that negative balance doesn't have much to do with the phosphorus that gets in the river.*" Instead, the overall intensity of agriculture seems to matter most. "*When I'm sitting here in Illinois in a watershed that's 95% corn and soybeans, it's going to lose some phosphorus*," he says, *"whether the balance is negative or positive*."

Phosphorus from human waste did prove significant. Chicago and other major metropolitan areas "showed up as hot spots," David says, because most municipalities don't remove phosphorus from the otherwise clean sewage effluent they discharge into streams. The team further found that about half of the variation in phosphorus loadings was not explained by their models, suggesting that other factors also contribute, such as stream bank erosion and phosphorus deposits in river sediments.

The findings suggest reducing phosphorus pollution will require broad adoption of practices that limit nutrient runoff, like cover crops, buffer strips, and incorporation of fertilizers. It will also require limits on phosphorus discharge from cities. Tackling these objectives across the entire Mississippi River Basin won't be easy. "*To me the value of the study is that it helps shift the debate*," David says. *"The problem is not as simple as two things. It's not as simple as too much fertilizer or manure.*" The research was funded by the National Science Foundation's Biocomplexity in the Environment/ Coupled Natural-Human Cycles Program.

Paul C Hay, Extension Educator
University of Nebraska-Lincoln Extension in Gage County ● 1115 West Scott Street, Beatrice NE 68310
(402) 223-1384 ● FAX: (402) 223-1370 ● email: phay1@unl.edu