

“Legacy Phosphorus” and Our Waters

A new study quantifies the need to reduce phosphorus in our soils—for the health of our lakes and rivers

For decades, phosphorus has accumulated in Wisconsin soils. Though farmers have taken steps to reduce the quantity of the agricultural nutrient applied to and running off their fields, a new study reveals that a “legacy” of abundant soil phosphorus has a large, direct and long-lasting impact on water quality.

The study, published in the journal *Ecosystems* and focused on southern Wisconsin’s Yahara watershed, may be the first to provide quantifiable evidence that eliminating the overabundance of phosphorus will be critical for improving the quality of the state’s lakes and rivers.

For example, the results indicate that a 50 percent reduction in soil phosphorus in the Yahara watershed’s croplands would improve water quality by reducing the summertime concentration of phosphorus in Lake Mendota, the region’s flagship lake, by 25 percent.

“If we continue to apply phosphorus at a greater rate than we remove it, then phosphorus accumulates over time and that’s what’s been happening over many decades in the Yahara watershed,” says Melissa Motew, the study’s lead author. Motew, working with CALS agronomy professor and co-author Christopher Kucharik, is a doctoral candidate at the UW–Madison Nelson Institute for Environmental Studies.

Phosphorus seeps into soils primarily by way of fertilizer and manure, and what crops and other plants don’t use to grow then leaks into waterways with rain and snowmelt runoff. Scientists have long believed that excess soil phosphorus is a culprit behind the murky waters and smelly algal blooms in some of Wisconsin’s lakes and rivers.

Conventional efforts, like no-till farming and cover crops, have tried to address nutrient runoff by slowing its movement from soils to waterways. However, the study shows that simply preventing runoff and erosion does not address the core problem of abundant soil phosphorus, and this overabundance could override conservation efforts.

“Solutions should be focused on stopping phosphorus from going onto the landscape or mining the excess amount that is already built up,” says Kucharik.

Using newly advanced computer models, the study shows the watershed has about four times more phosphorus in its soil than is recommended by UW–



Extension, which writes the state’s nutrient management recommendations based on what crops need and a landscape’s potential for nutrient runoff.

Currently, the only method known to draw down soil phosphorus is harvesting crops, but Kucharik explains that plants take up only a small amount of the surplus each year.

“It is unlikely that any cropping system will quickly draw down the excess,” he says.

It will require working with farmers to practice better nutrient accounting and counter the tendency of some to apply more fertilizer, as an insurance measure, than is needed.

Food production need not be compromised by potential solutions, Kucharik says. There is enough excess phosphorus in our soils “to support plant nutrient needs for a long time.”

The research, funded by the National Science Foundation, is part of UW–Madison’s Water Sustainability and Climate project.

—JENNY SEIFERT

Cropland in the Yahara watershed has an overabundance of soil phosphorus. Researchers say that makes clean lakes and rivers possible only with big changes in land and water management.