Lake Erie phosphorus-reduction targets challenging but achievable

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Large-scale changes to agricultural practices will be required to meet the goal of reducing levels of algae-promoting phosphorus in Lake Erie by 40 percent, a new University of Michigan-led, multi-institution computer modeling study concludes.

Last month, the U.S. and Canadian governments called for a 40-percent reduction, from 2008 levels, in phosphorus runoff from farms and other sources into Lake Erie. The nutrient feeds an oxygen-depleted "dead zone" in the lake and toxin-producing algal blooms, including a 2014 event that contaminated the drinking water of more than 400,000 people near Toledo for two days.

The main driver of the harmful algal blooms is elevated phosphorus from watersheds draining to Lake Erie's western basin, particularly from the heavily agricultural Maumee River watershed. About 85 percent of the phosphorus entering Lake Erie from the Maumee River comes from farm fertilizers and manure.

The new study, which integrates results from six modeling teams, was released today by the U-M Water Center. It concludes that meeting the 40-percent reduction target will require widespread use of strong fertilizer-management practices, significant conversion of cropland to grassland and more targeted conservation efforts.

"Our results suggest that for most of the scenarios we tested, it will not be possible to achieve the new target nutrient loads without very

significant, large-scale implementation of these agricultural practices," said U-M aquatic ecologist Don Scavia, lead author of the new study and director of the Graham Sustainability Institute, which oversees the Water Center.

"It appears that traditional voluntary, incentive-based conservation programs would have to be implemented at an unprecedented scale or are simply not sufficient to reach these environmental goals, and that new complementary policies and programs are needed."

The researchers developed a list of potentially effective cropland management practices after consulting with agricultural and environmental experts. They examined various options for fertilizer application, tillage operations, crop rotations and land conversion.

Various management options were combined to create 12 scenarios that were each tested using six computer models. The watershed models tested the ability of each scenario to achieve the proposed 40 percent phosphorus-reduction target. The scenarios examine both the total amount of phosphorus, known as TP, and the amount of dissolved reactive phosphorus (DRP), the form of the nutrient that is most stimulating to algae.

"The most promising scenarios included widespread use of nutrient management practices—especially subsurface application of phosphorus-based fertilizers—along with substantial conversion of cropland to grassland and extensive use of buffer strips," said study co-author Jay Martin of Ohio State University.

Even so, the researchers determined that seven of the 12 cropland-management scenarios would not meet the goal of a 40-percent reduction in total phosphorus entering western Lake Erie from the Maumee River watershed.

One of the five scenarios capable of reaching the TP target (Scenario 6) requires taking nearly 30,000 acres of cropland out of production and putting more than 1.5 million acres under stringent conservation practices. Because the average size of a farm in the Maumee River watershed is 235 acres, this is equivalent to impacting more than 6,300 farms.

One of the scenarios (Scenario 2) that reach the target for dissolved reactive phosphorus requires enhanced nutrient management on all 3.1 million acres of row-crop fields in the watershed, which equates to impacting roughly 13,000 farms.

"While there may be a temptation to select one model based on 'superior performance,' there is no one way to evaluate model performance. Instead, we chose to use multiple models because together they represent the range of reasonable representations of the real world," said study co-author Margaret Kalcic, one of the U-M Water Center's lead modelers.

"Research like this is valuable to help inform on-the-ground conservation efforts, such as the 4R Nutrient Stewardship Program currently underway in Ohio. We will only solve this problem with the right mix of land and water management practices, deployed in the right place and amount," said study co-author Scott Sowa of The Nature Conservancy.

Meeting phosphorus-reduction targets has proved difficult elsewhere in the United States. Specific goals for reducing the size of the Gulf of Mexico's oxygen-starved "dead zone" have existed for 15 years, but almost no progress has been made. And water-quality improvement goals for the Chesapeake Bay were in place for decades before some limited progress was made.

More information: The new Lake Erie report is titled "Informing

Lake Erie agriculture nutrient management via scenario evaluation."

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