Reading this summer’s media coverage of Lake Erie’s water quality woes, you might conclude that the lake’s harmful algal blooms (HABs) would stop if farmers simply fertilized less. But as anyone who knows the complexities of natural and managed systems can tell you, silver bullet solutions don’t exist—no matter how much government officials and the public may want them in the wake of Toledo’s drinking water crisis in early August.

For one thing, the agricultural community is well aware that the load of dissolved reactive phosphorus—the main fuel for HABs—has been rising in Lake Erie since the late 1990s, even as total phosphorus has held steady or declined. What’s still not clear is exactly why. “There are a lot of people who will place blame on one thing or another. But I think it’s a combination of many factors: everything from climate change to the forms of fertilizer we use to the way we’re applying it,” says Douglas R. Smith, a USDA-ARS phosphorus expert.

“Why the dissolved fraction has gone up, that’s the big unknown,” agrees Kevin King of USDA-ARS in Ohio. “We’re all out here trying to find management practices to address the problem. My concern is we haven’t even identified why it occurred in the first place.”

Secondly, adds King, the amount of phosphorus escaping from farm fields today is inconsequential from a crop production standpoint: just a half pound to a pound per acre, on average. Yet, roughly this same amount appears to be what’s driving the lake’s troublesome blooms. “So from an agronomic standpoint, the farmer is doing great,” King says. “But from an environmental standpoint, [the loss] is very significant.”

Where does this leave CCAs and their clients? “One of the things we need to wait for is more data,” says Ohio CCA Board Chair Tim Berning, who likens the problem to baking a cake. If the ingredients are altered even slightly from batch to batch, the cake’s final flavor and texture can be very different each time. “I think that’s a very good analogy to the phosphorus situation,” Berning says. “We know some things have changed. We just haven’t identified exactly what changes are allowing phosphorus to leave the fields.”

Much of the needed research is now under way, Berning adds. What follows are some of the leading suspects in Lake Erie’s difficulties and hints of new practices that could eventually emerge.

**Tile drainage**

Farmers have contended for years with nitrate losses through the tile system. Until recently, however, most people thought phosphorus transport in tile wasn’t important because the measured concentrations were so low—usually well below 1 ppm, Smith explains. New studies by him, King, and others are showing, however, that 40 to 50% of the losses of both dissolved and total phosphorus can occur via tile on average, a percentage much higher than previously thought. And though the concentrations are still low, scientists now understand the environmental punch they can pack.

In recent work led by King, for example, phosphorus concentrations in tile discharge represented less than 2% of what farmers typically apply on fields. Yet, more than 90% of these same concentrations exceeded 0.03 ppm, the recommended limit for curtailing HABs. The problem is compounded by the vast of number of acres that are tiled today, adds University of Arkansas phosphorus expert Andrew Sharpley. “With many, many fields each contributing a small amount of phosphorus, that can add up to a large amount,” he says.

One possibility for addressing the issue is drainage water management. The practice is already known to cut nitrate transport in tile drainage significantly, and several studies now indicate it can control phosphorus losses, too. Based on this, King notes, the state of Ohio recently authorized a substantial cost-share program for the practice.
Tillage

When Lake Erie’s water quality first began declining in the 1970s, many producers adopted conservation tillage to prevent movement of sediment-bound phosphorus, and the shift has helped reduce total phosphorus in the lake dramatically. Ironically, though, conservation tillage may be contributing now to rising levels of dissolved phosphorus.

One issue is that many farmers still broadcast-apply phosphorus on the surface, where it builds up quickly if it’s not tilled in or otherwise incorporated. In fact, soil test phosphorus levels in the uppermost half-inch of soil can exceed levels in the top eight inches by two to three times, King says.

As a result, excess phosphorus not only runs off the surface more readily; it may also bypass the bulk soil and enter the tile system through preferential flow paths. Reduced tillage, for example, encourages the development of macropores: large, beneficial pores that help aerate the...
Fertilizer recommendations

Row crop farmers on the Ontario side of Lake Erie do many things the way their American counterparts do, says Keith Reid of Agriculture and Agri-Food Canada. For example, roughly 30 to 40% follow the same “rotational tillage” practice of tilling before corn and then no-till planting soybean or winter wheat into the corn stubble. One big difference, though, is that most Ontario growers don’t broadcast-apply phosphorus, nor do they typically fertilize in the fall.

“The go-to way of managing phosphorus is to band it below the surface, either at or close to planting time,” Reid says. The routine is part of a “sufficiency” approach to fertilization, which aims to get a crop response that will pay for the fertilizer and maximize net returns in the current year.

The Tri-State Fertilizer Recommendations for Ohio, Michigan, and Indiana, in contrast, follow a “build up and maintenance” strategy. In it, phosphorus levels are increased to where they no longer limit yields and then maintained. “And when all you’re doing is maintaining, it doesn’t matter how you apply fertilizer,” Reid says, meaning farmers usually opt for the cheapest, easiest approach: broadcasting. “This is frequently done in the fall to manage spring workload,” he adds, but then farmers may not incorporate the fertilizer until the following spring.

There are pro and cons to both strategies. Build up and maintenance generally costs more, for example, while sufficiency exposes growers to some risk of reduced yields. But the sufficiency approach also clearly cuts the chance of phosphorus losses since it uses less fertilizer and fertilizer is applied below the soil surface at planting, rather than months ahead.

While the environmental benefits of sufficiency are clear, however, Reid and his colleagues have tried not to be heavy handed in their advice. Instead, they explain the reasoning behind the two strategies and let people decide for themselves. “Too often in the past, it’s been, ‘Well, they’re different [methods], but I’m right and you’re wrong,’” he says. “That’s not a helpful approach.”

4Rs

If much of this sounds familiar, that’s because it is. Managing drainage water, placing phosphorus below the surface, and fertilizing in time with crop needs—all are part of the suite of nutrient stewardship principles known as the 4Rs (www.nutrientstewardship.com).

Long before the crisis in Toledo made headlines this summer, efforts were already under way to widen adoption of the program. As a prime example, the ICCA Board voted in mid-September to support development of a new certification specialty in 4R nutrient management. The program expects to offer the first 4Rs exam in August 2015.

Meanwhile, the Ohio Agribusiness Association (OABA) and several partners have launched a new 4R certification program (4rcertified.org) for ag retailers—as opposed to individuals—in the Lake Erie Basin. The first of its kind in the country, the program certifies with third-party verification that retailers are adhering to 4R principles in their business practices, explains OABA president Chris Henny. Fifty retailers out of an estimated 300 in the western Lake Erie Basin have already enrolled.

“Using the 4Rs is going to be really, really critical,” says Deanna Osmond, a nutrient management expert at North Carolina State University, adding that she believes the program isn’t being implemented to nearly the extent it should be. At the same time, the scientists agree that the 4Rs by themselves won’t bring Lake Erie back to health. “We’re going to have to find some other measures,” King says.

To this end, he and collaborators from several other institutions are studying the impacts on phosphorus loss of a broad collection of farm practices, including spring versus fall applications, banding versus broadcasting, organic versus inorganic fertilizers, cover crops, phosphorus-binding amendments such as gypsum, and various forms of tillage. The research is taking place on 17 farms in the western Lake Erie Basin and two other Ohio watersheds, and King is confident it will eventually yield new solutions.

Still, there’s a tricky balance to be achieved between maintaining productivity on the land and further reducing nutrient losses, or what Reid calls “hitting the sweet spot.” So people need to try for patience.

“Unfortunately, we need time now,” King says. “This thing didn’t happen overnight, and it’s not going to get cleared up overnight.”