# World phosphorous use crosses critical threshold

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(PhysOrg.com) -- Recalculating the global use of phosphorous, a fertilizer linchpin of modern agriculture, a team of researchers warns that the world's stocks may soon be in short supply and that overuse in the industrialized world has become a leading cause of the pollution of lakes, rivers and streams.

Writing in the Feb. 14 edition of the journal *Environmental Research Letters*, Stephen Carpenter of the University of Wisconsin-Madison and Elena Bennett of McGill University report that the human use of phosphorous, primarily in the industrialized world, is causing the widespread eutrophication of fresh surface water. What's more, the minable global stocks of phosphorous are concentrated in just a few countries and are in decline, posing the risk of global shortages within the next 20 years.

"There is a finite amount of phosphorous in the world," says Carpenter, a UW-Madison professor of limnology and one of the world's leading authorities on lakes and streams. "This is a material that's becoming more rare and we need to use it more efficiently."

Phosphorous is an essential element for life. Living organisms, including humans, have small amounts and the element is crucial for driving the energetic processes of cells. In agriculture, phosphorous mined from ancient marine deposits is widely used to boost crop yields. The element also has other industrial uses.

But excess phosphorous from fertilizer that washes from farm fields and suburban lawns into lakes and streams is the primary cause of the algae blooms that throw freshwater ecosystems out of kilter and degrade water quality. Phosphorous pollution poses a risk to fish and other aquatic life as well as to the animals and humans who depend on clean fresh water. In some instances, excess phosphorous sparks blooms of toxic algae, which pose a direct threat to human and animal life.

"If you have too much phosphorous, you get eutrophication," explains Carpenter of the cycle of excessive plant and algae growth that significantly degrades bodies of fresh water. "Phosphorous stimulates the growth of algae and weeds near shore and some of the algae can contain cyanobacteria, which are toxic. You lose fish. You lose water quality for drinking."

The fertilizer-fueled algae blooms themselves amplify the problem as the algae die and release accumulated phosphorous back into the water.

Carpenter and Bennett write in their Environmental Research Letters report that the "planetary boundary for freshwater eutrophication has been crossed while potential boundaries for ocean anoxic events and depletion of phosphate rock reserves loom in the future."

Complicating the problem, says Carpenter, is the fact that excess phosphorous in the environment is a problem primarily in the industrialized world, mainly Europe, North America and parts of Asia. In other parts of the world, notably Africa and Australia, soils are phosphorous poor, creating a stark imbalance. Ironically, soils in places like North America, where fertilizers with phosphorous are most commonly applied, are already loaded with the element.

"Some soils have plenty of phosphorous, and some soils do not and you need to add phosphorous to grow crops on them," Carpenter notes. "It's

this patchiness that makes the problem tricky."

Bennett and Carpenter argue that agricultural practices to better conserve phosphate within agricultural ecosystems are necessary to avert the widespread pollution of surface waters. Phosphorous from parts of the world where the element is abundant, they say, can be moved to phosphorous deficient regions of the world by extracting phosphorous from manure, for example, using manure digesters.

Deposits of phosphate, the form of the element that is mined for agriculture and other purposes, take many millions of years to form. The nations with the largest reserves of the element are the United States, China and Morocco.

Provided by University of Wisconsin-Madison