

Researchers quantify worldwide loss of phosphorus due to soil erosion for the first time

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Phosphorus is essential for agriculture, yet this important plant nutrient is increasingly being lost from soils around the world. The primary cause

is soil erosion, reports an international research team led by the University of Basel. The study in the journal *Nature Communications* shows which continents and regions are most strongly affected.

The world's food production depends directly on [phosphorus](#). However, this plant nutrient is not unlimited, originating from finite geological reserves. How soon these reserves might be exhausted is the subject of scholarly debate. Just as controversial is the question of which states own the remaining reserves, and the resulting political dependencies.

Quantification using high-resolution data

An international research team led by Professor Christine Alewell has investigated which continents and regions worldwide are suffering the greatest loss of phosphorus. The researchers combined high-resolution, spatially discrete global data on the phosphorus content of soils with local erosion rates. Based on this, they calculated how much phosphorus is lost through erosion in different countries.

An important conclusion of the study is that more than 50% of global phosphorus loss in agriculture is attributable to [soil erosion](#). "That erosion plays a role was already known. The extent of that role has never before been quantified with this level of spatial resolution," Alewell explains. Previously, experts reported losses primarily due to lack of recycling, food and feed waste, and general mismanagement of phosphorus resources.

Too little in the field, too much in the water

Erosion flushes mineral-bound phosphorus out of agricultural soils into wetlands and [water bodies](#), where the excess of nutrients (called eutrophication) harms the aquatic plant and animal communities. The

researchers were able to validate their calculations using globally published measurement data on phosphorus content in rivers: The elevated phosphorus content in waters mirrors the calculated loss of phosphorus in the [soil](#) in the respective region.

Mineral fertilizers can replace the lost phosphorus in the fields, but not all countries are equally able to use them. Although solutions are possible for countries such as Switzerland thanks to organic fertilizers and potentially relatively closed phosphorus cycles in agriculture, Africa, Eastern Europe and South America register the greatest phosphorus losses—with limited options for solving the problem. "It's paradoxical, especially as Africa possesses the largest geological phosphorus deposits," says Alewell. "But the mined phosphorus is exported and costs many times more for most farmers in African countries than, for example, European farmers." In Eastern Europe economic constraints are also the most crucial factor of phosphorous deficiency.

South America could potentially mitigate the problem with efficient use of organic fertilizer and/or better recycling of plant residues. On the other hand, farmers in Africa do not have this option, as Africa has too little green fodder and too little animal husbandry to replace mineral fertilizers with manure and slurry, says Alewell.

Who will control reserves in the future?

It is still unclear when, exactly, phosphorus for global agriculture will run out. New, large deposits were discovered a few years ago in Western Sahara and Morocco, although their accessibility is questionable. In addition, China, Russia, and the U.S. are increasingly expanding their influence in these regions, which suggests that they might also control this important resource for future global food production. Europe has practically no phosphorus deposits of its own.

"Ninety-five percent of our food is directly or indirectly produced as a result of plants growing in the soil. The creeping loss of the plant nutrient phosphorus should be of concern to all people and societies," says Alewell. If countries want to secure their independence from those states that possess the remaining large deposits, they must seek to minimize phosphorus losses in soils.

A drastic reduction in soil erosion is an important step in the right direction. Land managers can reduce [erosion](#) by ensuring ground cover for as long as possible; for example, through mulching, green manure and intercropping, and through topography-adapted cultivation—tilling fields transversely to the slope or terracing.

More information: Christine Alewell et al. Global phosphorus shortage will be aggravated by soil erosion, *Nature Communications* (2020). [DOI: 10.1038/s41467-020-18326-7](https://doi.org/10.1038/s41467-020-18326-7)

Provided by University of Basel

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