Food security might be threatened by phosphorous loss due to erosion

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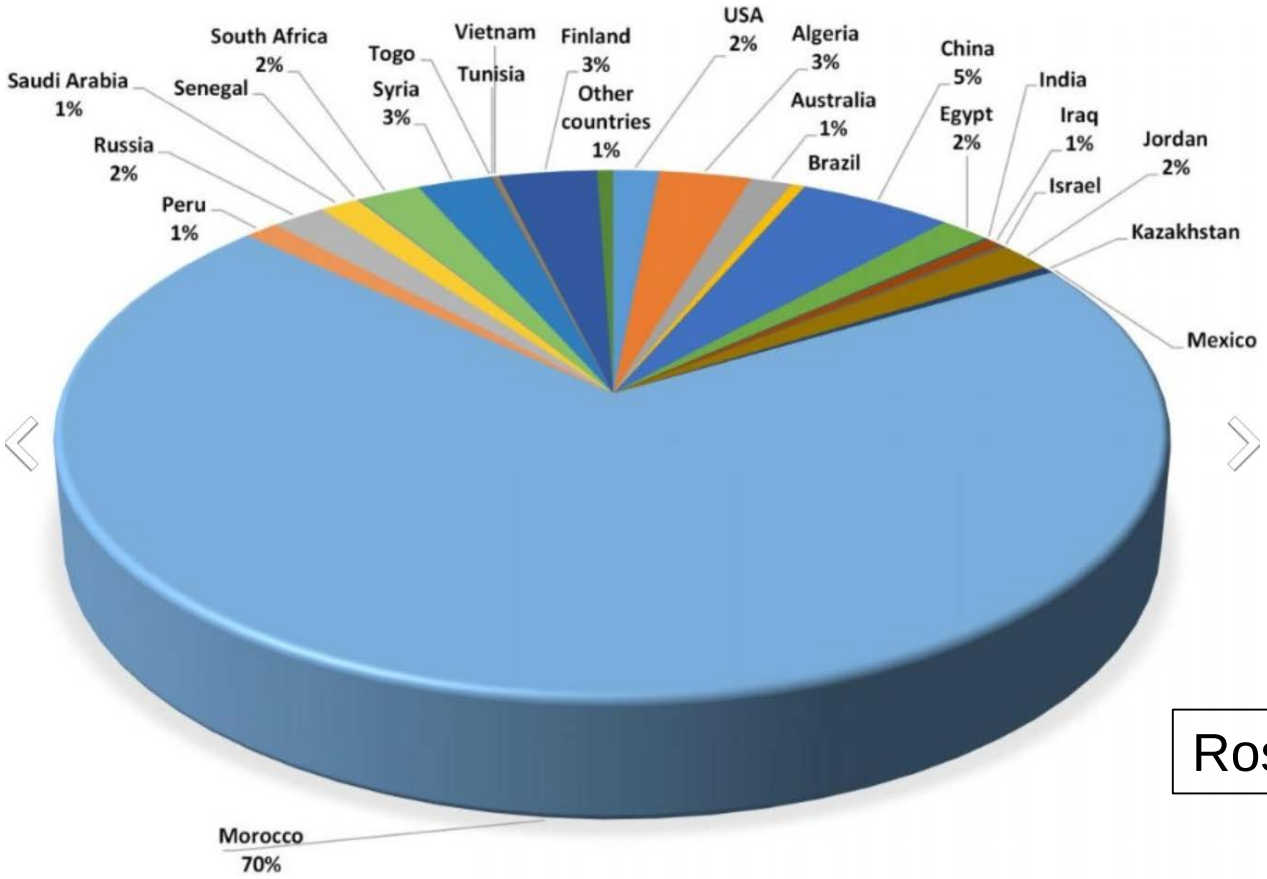
Soil Phosphorus is…

- essential for plant growth and productive agricultural management
- threat to ecosystem health due to eutrophication of waters
- key limiting nutrient of future food and feed production because supply stems from non-renewable geological deposits



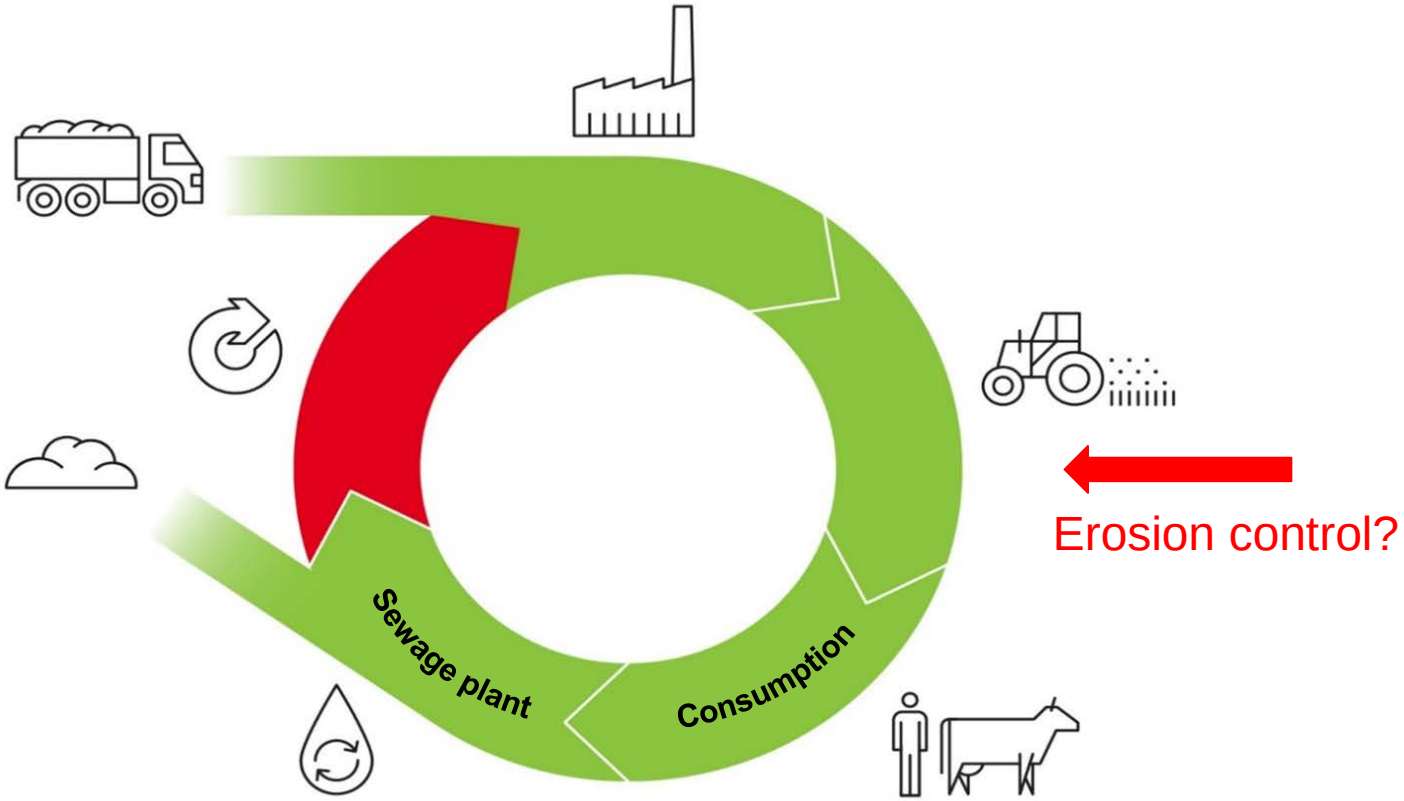
P resources globally

Rosemarin, 2016

P shortage globally?

- China in 2007: 135% export tariff on products containing phosphate (preventing any export…)
- African continent is the worlds largest exporter and the one with the largest food shortage
- P fertilizer might cost an African farmer 2-6 times more than an European farmer (higher transport and storage costs)
- Switzerland = 100% reliant on P imports: 15,000 tonnes annually

Leading role of Switzerland?
Closing cycles through phosphorus recycling



Article 15 of the Waste Ordinance (ADWO): By 1 January 2026, phosphorus must be recovered from municipal waste water, sewage sludge, sewage sludge ash and P-rich waste and then recycled.

Courtesy of Kaarina Schenk, Waste Management and Resources Division, BAFU

Soil Phosphorus is…

- lost from agro-ecosystems mostly due to soil erosion which recent assessments of global phosphorus cycling largely neglected or addressed very simplistically

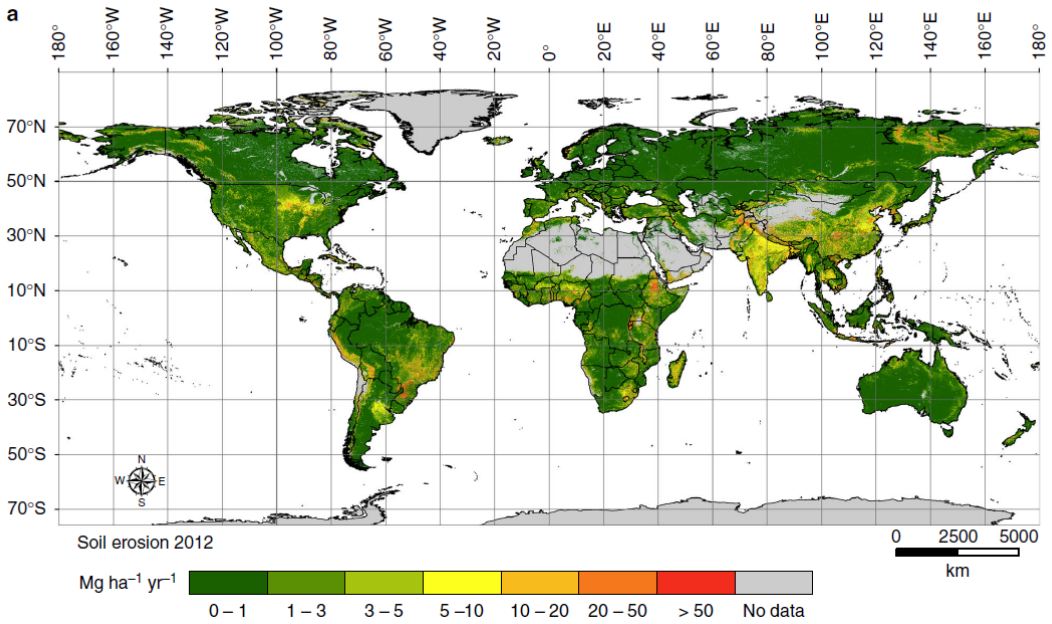
Photo: https://www.lathamseeds.com/app/uploads/2020/01/iStock-1146146343.jpg

Our aim…

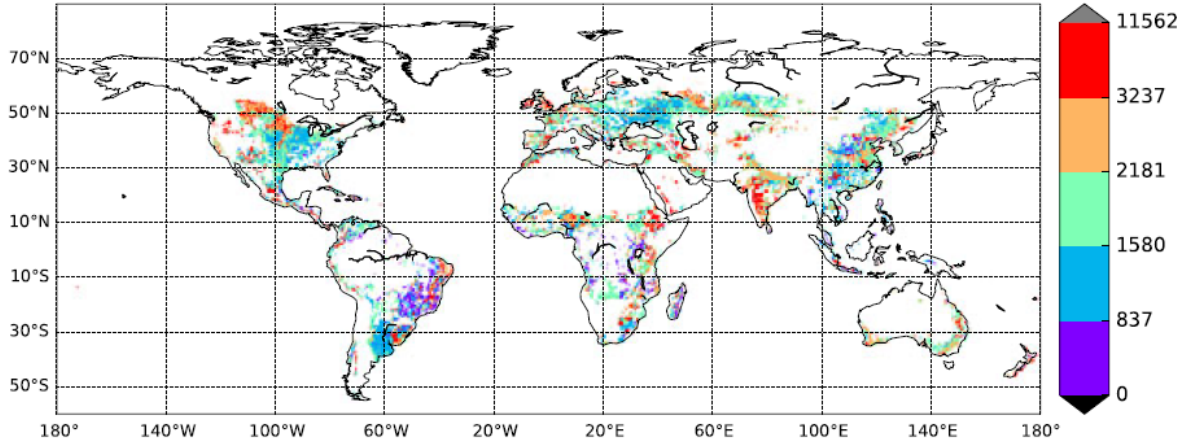
➔ assessing P loss due to soil erosion on a global scale

Approach

Spatially discrete soil erosion rates from Borelli et al., 2017

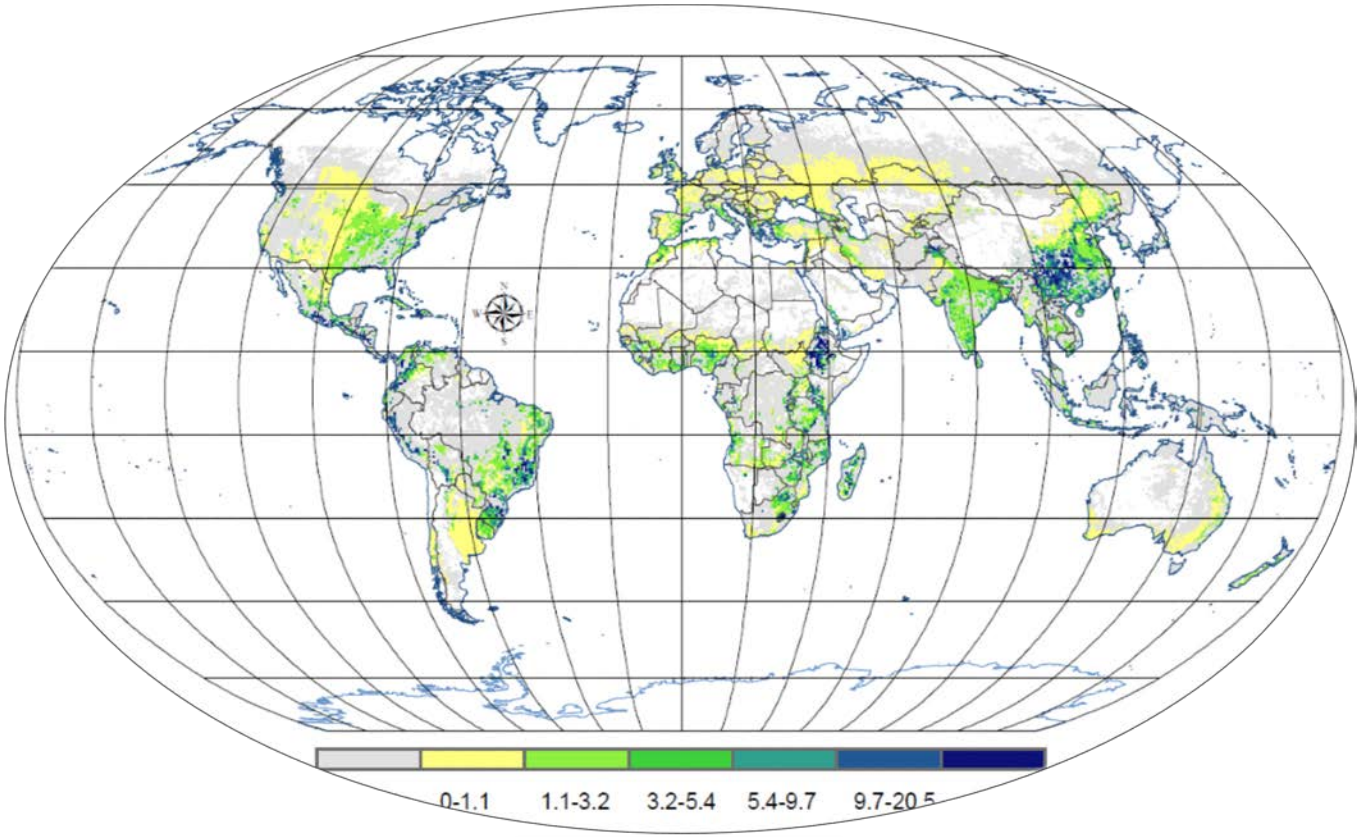


P_{TOT} : mean of the simulations



Spatially discrete soil P contents from Ringeval et al., 2017

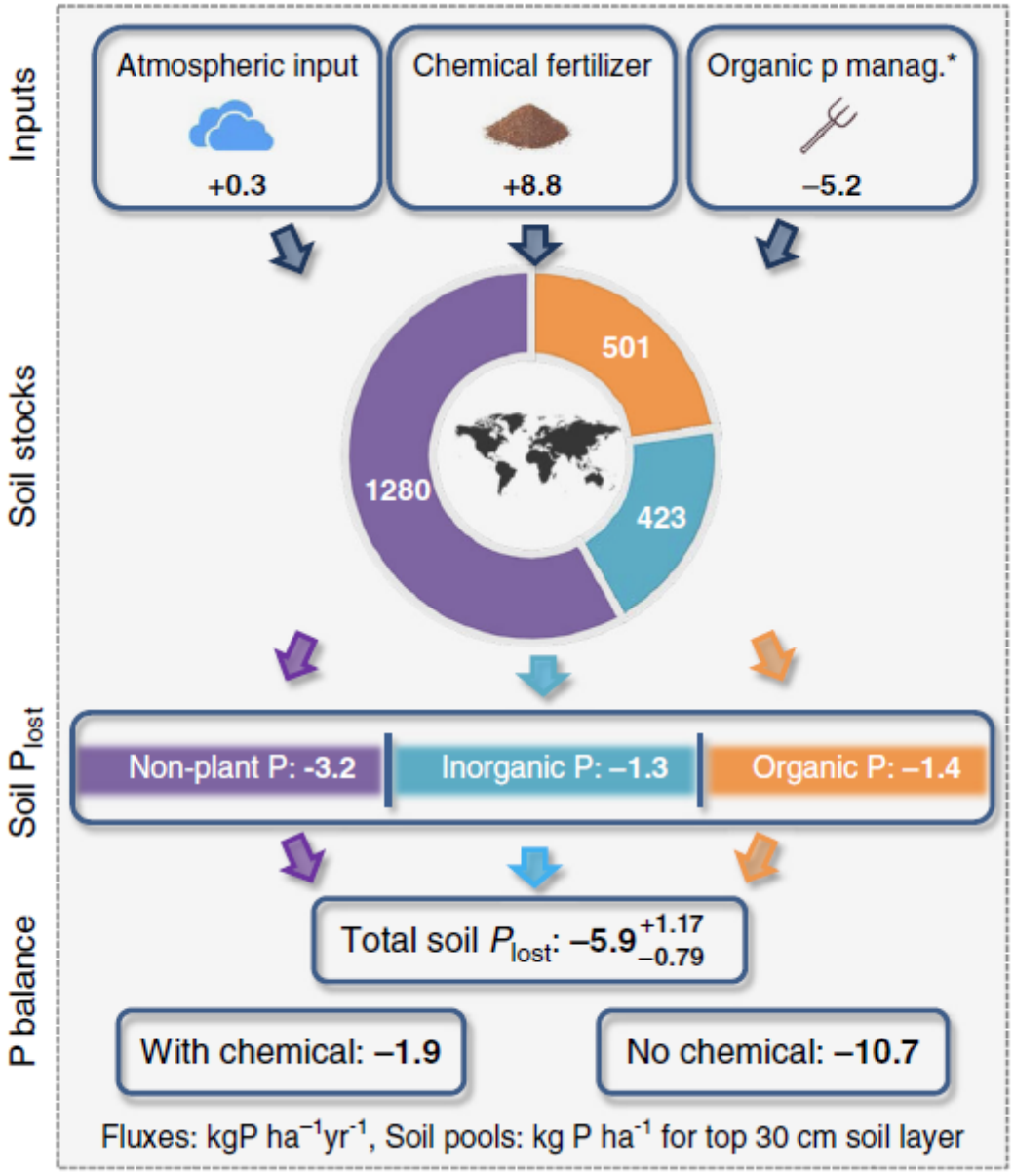
Global P losses due to soil erosion



(kg P ha^{-1} yr^{-1})

- Very high losses: Eastern China, Indonesia, regions of south-eastern Africa, Central America and South America
- High losses: most of India, regions of Southern Africa and South America

Alewell et al., 2020

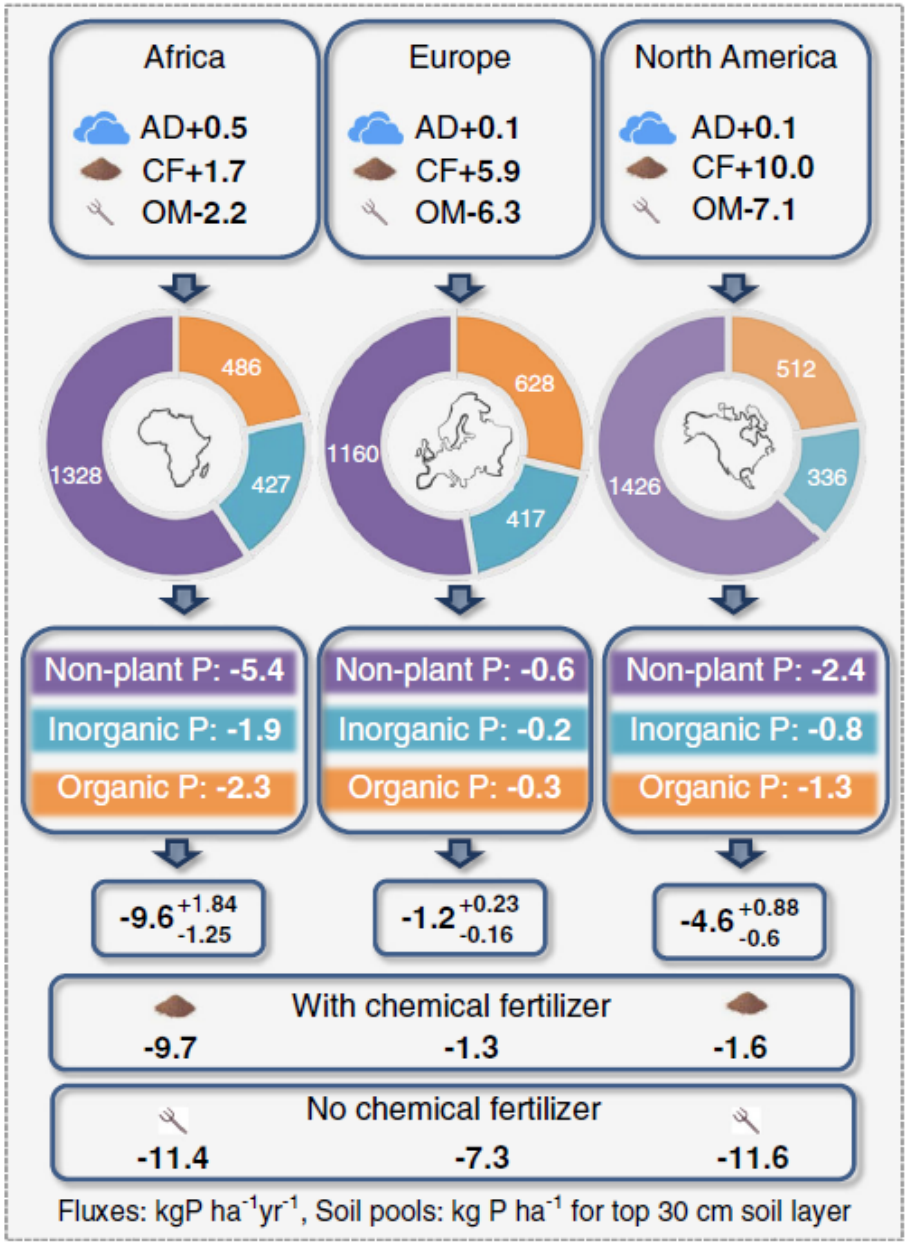


Global P soil pools and depletion due to erosion.

Arrows indicate fluxes (positive: net input to soils, negative: depletion of soils). *Organic P management = sum of manure and residue input minus plant uptake. Nonplant P = non-plant available P. Inorganic and organic P give plant available fractions. Total soil P: sum of P fractions lost from soil via erosion with relative errors. No/with chemical= P balance with and without chemical fertilizer.

- High chemical fertilizer input globally
- 67% on average of the fertilizer input is lost via erosion
- A hypothetical total P fertilizer scarcity would mean a yearly depletion on arable fields of -10.7 kg ha^{-1}yr^{-1}

Alewell et al., 2020



Soil P pools and depletion due to erosion in Africa, Europe and North America.

- Africa: low fertilizer input, very high erosion: with or without fertilizer
  ➔ high losses
- Europe and North America: medium to high fertilizer input, medium losses due to erosion. With no or low fertilizer availability
  ➔ high depletion

OPEN QUESTIONS:

? How can we feed the world without P?

? How can we reduce Erosion in Africa, South America, Asia?

Alewell et al., 2020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Thank you for your attention!