



THESIS

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Could soil phosphorus availability limit organic production in a context of strong expansion?

Previous studies^{1,2} have shown that converting 60% of arable land to organic farming could meet global food demand, provided that food systems are reorganized (food waste reduction, diet change, change in spatial distribution of livestock system, etc.). Beyond this threshold, nitrogen limitations would be so severe that production could not meet demand. This study complements previous research by examining the availability of phosphorus (P) in soils. Mineral phosphate fertilizers, which account for more than half of global phosphorus inputs into agricultural soils, are, like nitrogen fertilizers, prohibited in organic farming.

Simulations of a world with 100% organic farming agriculture revealed a phosphorus deficit in agricultural soils in the long term. This would be particularly severe in regions where current soil phosphorus fertility is low, crop yields are high, and leguminous crops are widespread. And it will be added in every regions to a short term limitation of agricultural production due to nitrogen. After 100 years of worldwide organic farming, phosphorus limitation would lead to a 12% decrease in production on cultivated land compared to current levels. When combined with the impact of biotic and nitrogen stresses, the total decline in production would be 56%. In view of phasing out mineral phosphate fertilizers, this thesis discusses solutions for the sustainable management of phosphorus reserves in agricultural soils, which can only be achieved by reducing losses, particularly through erosion, or by recycling phosphorus from human excreta.

¹ Barbieri et al. (2021)

² Muller et al. (2017)