

Science for Environment Policy

More dynamic indicators needed to measure phosphorus's availability

Current knowledge on the availability of mineral resources is explored in a recent study, which focuses on phosphorus as a key example. Static measures of availability, such as the consumption-to-production ratio, are useful as early warning signals, the researchers suggest, but more dynamic indicators that consider technological development and population change are needed to better inform policy.

The increasing use of phosphorus as a fertiliser not only raises concerns about the mineral's impact on the environment, when used in excess, but also about the industry's [sustainability](#), as there is a limited availability of phosphate that can be mined from rock reserves.

Usually when a commodity is in shortage in a market economy, its price will rise. This often triggers increased investment in improving supply. However, phosphorus production is concentrated in a few countries (China, USA and Morocco), and non-producing, impoverished countries, such as those in sub-Saharan Africa, are badly affected by price increases. As such, many argue that policy needs to stabilise prices in order to reduce this social inequality, whilst maintaining market competition and innovation.

To be effective, such policies should be based upon an appropriate evidence-base on phosphorus availability, but calculating availability is a major challenge. Currently, there is a distinction between 'resources' and 'reserves', where 'resources' represent the actual amount of phosphorus in existence, and 'reserves' are the amount that is financially feasible to extract with available technology. The availability of phosphorus is usually described using the concept of 'reserves'. Estimates of current phosphate rock reserves vary considerably, from 15,000 megatons (Mt) to 624,000 Mt. Estimates of current resources vary between 47,000 Mt and 1,200,000 Mt.

One of the simplest ways to estimate *future* phosphorus availability is the reserve/consumption (R/C) ratio. In 2003 it was estimated that reserves were just 130 times greater than the amount we consume, but in 2010 it was estimated that phosphorus reserves were actually 369 times greater, thanks to a large increase in estimates of Moroccan reserves, from 5700 Mt to 50,000 Mt in 2009. The ratio is very high compared to other commodities, such as chromium, which has an R/C ratio of only 18. This can give the impression that phosphorus availability is not a problem in the short-term, but the reality is more complex.

The R/C ratio does not consider change on either the supply side (e.g. technological development) or the demand side (e.g. population dynamics) and more dynamic indicators are available. For example, the Hubbert curve provides an estimate of peak phosphorus (the time when maximum global production is reached) that considers declining ore grades, available technologies and demand changes. A number of different estimates of peak times have been made, some of which are as early as 2030. However, this study argues that, although there may eventually be a peak of phosphorus supply, it is more likely there will be several demand-driven production plateaus and multiple peaks in the near future.

Current indicators of phosphorus availability can be used as 'early warning systems' to encourage innovation or increased mining, the study suggests. These would reduce short-term price peaks and impacts on food security. However, better dynamic modelling of phosphorus availability, with insight from science, industry and policy, would improve understanding of the interactions between supply and demand.



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