Phosphorus flows in the Netherlands: options for a more sustainable use

A.L. Smit[1], J.C. van Middelkoop[2], W. van Dijk[3], H. van Reuler[3] , P.A.M. van de Sanden[1]

[1] Plant Research International, Wageningen UR; [2] Livestock Research, Wageningen UR, [3] Applied Plant Research (PPO), Wageningen UR, the Netherlands
bert.smit@wur.nl

Phosphorus (P) is one of the major nutrients needed to sustain life. The low concentration of P in most agricultural soils, along with its low solubility, makes P a key limiting factor for plant growth nearly everywhere on the world. In the past, natural ecosystems and low-input agricultural systems adapted to the low P availability by recycling P from organic waste streams (litter, refuse, night soil). Animal manure was used as much as possible and was also collected from grazing outside the farm. External P-inputs became available in the second half of the 19th century through the mining of phosphate deposits. This led to large ecological and agricultural changes including the development of agro-production systems without a (negative) P-feedback (Duncan Brown, 2003). As a consequence these changes reduced the need for P-recycling from organic waste streams, including manure. This led to the current situation that globally food production cannot maintain its current level without fertiliser. However, P–resources are finite.
Taking this into account it is striking that the remaining P-reserves are nowadays not used as they should be, namely as an essential resource to produce food for the estimated nine billion people on earth in 2050. To realize a more sustainable use of P we first analysed the P cycle on the global scale and identified various reasons for the apparent low efficiency of fertilizer (from "mine to fork" only 20% (Cordell, 2010)) and distinguished between i) direct losses (mining losses, erosion), ii) missed opportunities (non-recycling of waste streams, such as slaughter waste and sewage sludge) and iii) accumulation of P in soil (on various scales).
The Netherlands are a prime example of countries with a highly intensive and specialized agriculture. Livestock and arable production became spatially separated leading to regional P-accumulation in soils and to less P recycling (also induced by some societal developments). For its use of P, the Netherlands is totally dependent on sources outside the country, the main flow now being the import of feed (soybean etc.) from South America. Like the rest of Europe, this might be in the future a vulnerable situation when P-resources become exhausted.
To investigate the possibilities for a more sustainable use of the remaining P-resources, an identification and quantification of the major national P-flows was done (in agriculture, industry and society). This provided us with data on various topics such as i) P-accumulation in agricultural soil, ii) losses to the environment, iii) degree of recycling and reuse of P in waste streams etc. It allowed us to identify and quantify the potential for P-recycling at various points in the national P-flow diagram. The outcome of preliminary scenario studies will be discussed

Duncan Brown A. 2003. Feed or feedback. International books; ISBN 905727048X.
Cordell, D. 2010. The story of Phosphorus. PhD thesis Linköping University.