

Phosphorus depletion: the invisible crisis

© Phosphorus shortage as a threat

Global reserves of phosphorus are running out and, since plants need phosphate to grow, this poses an enormous challenge for global food production in the foreseeable future. A shortage of phosphate could ultimately result in large-scale famine and social-political turmoil. Surprisingly, phosphorus depletion did not seem to be on the political agenda some time ago. In order to increase awareness of these problems, the Netherlands Water Partnership, WASTE and Plant Research International initiated a one year DPRN process in 2009 to place the issue on the Dutch and European political agendas.

A key question is whether it will be possible to feed a growing global population in the future. Often it is simply assumed that resources necessary for increased food production will be just as available as they are today. This might not be the case for phosphorus (P) which is a macronutrient indispensable for plant growth, and also irreplaceable.

In the pre-industrialised era, when there was a much smaller global population, crop production relied on natural phosphorus supplies in



Phosphate mining (Source: Wikimedia).

Process organisation

The 'Phosphorus depletion: the invisible crisis' process was carried out within the framework of the Development Policy Review Network (DPRN) by:

- The Netherlands Water Partnership
- WASTE
- Plant Research International – Wageningen University and Research Centre (WUR)

The three process organisers are members of the Nutrient Flow Task Group (NFTG). The NFTG is a growing and open network of organisations which aims to draw attention to the depletion of phosphorus and other nutrients and the global impact thereof.



the soil, with or without additional supplies from organic manure. Human excreta were also used as input. Increased food production was necessary to feed the growing global population. This became possible from around 1850 onwards, based on the input of artificial fertilisers, which boosted agriculture tremendously. However, since phosphorus is an important component of artificial fertilisers, this also accelerated phosphorus use.

Currently we are in a situation in which global food supply has become dependent on continual inputs of phosphate fertiliser to maintain soil fertility. However, phosphate deposits are finite. The problem of phosphorus depletion is

further complicated by the fact that, similarly to fossil fuels, the control of phosphorus resources is in the hands of a limited number of countries. Most of the known reserves are in Morocco, the US and China and the latter recently imposed an export tariff on phosphate.

🌐 Sustainable use of phosphorus

Bert Smit and other PRI researchers wrote a report that addresses global phosphorus resources and trends. This report provided the scientific basis for the other process activities. The authors estimate that, considering the expected increase in food and energy consumption of the growing world population, today's economically exploitable phosphorus resources will be depleted within 75 years. They mention several possibilities for a more sustainable use of phosphorus:

- Measures to prevent erosion are crucial because large losses occur due to soil erosion and runoff. Phosphorus eventually ends up in the ocean's sediments where it cannot be recovered using current technology.
- Manure should be used more efficiently. Livestock concentration (i.e. the number of animals) should be in balance with the surrounding area of arable land. In this way the excess of animal manure will not lead to an accumulation of phosphorus in the soil.
- Technology should be developed to recycle the phosphorus in waste like human excreta, crop residues, slaughter waste and other organic rest streams. In order to improve the recycling rate, current regulations at national and EU levels may need to be revised.
- Current fertiliser recommendation schemes need to be critically reviewed, and possibilities for increasing the efficiency of phosphorus fertilisation strategies within agriculture should be explored.
- Breeding technologies that make plants more efficient in mobilising phosphorus in the soil should be stimulated.

The authors stress the need to re-use and re-cycle phosphorus. This requires joint efforts involving various disciplines and expertise. Importantly, coordinated global governance related to the remaining phosphorus resources demands increased awareness of the problem, not only at the level of international organisations and governments, but also at the level of 'the man in the street'.



Recycling human excreta, especially urine, will save large amounts of phosphorus (Source: <http://inhabitat.com>).

🌐 Sustainable phosphorus use in the Netherlands

According to a report by Plant Research International, there are several ways in which phosphorus can be used more sustainably in the Netherlands.

- Livestock should be in balance with the surrounding area of arable land. The most drastic measure would be to reduce the number of P-excreting animals in the country in the long run. However, such a policy would have serious economic consequences.
- Current fertiliser recommendation schemes should be subjected to critical judgment. The potential trade-off between phosphorus use and yields or crop quality should be quantified for various situations in order to achieve a lower phosphorus fertility level.



Livestock should be in balance with the surrounding area of arable land (Source: Wikipedia).

- Possibilities for increasing the efficiency of phosphorus fertilisation strategies within agriculture should be explored. Precision farming offers possibilities for using fertiliser P more efficiently (e.g. placement of fertiliser). Plant breeding based on plant properties which mobilise phosphorus in the soil more efficiently should also be stimulated.
- Critical evaluation of P-additions to animal food.
- Besides a more efficient use of manure, initiatives should be oriented around improving recycling of P in waste streams like household and slaughter waste. After incineration of these waste streams the P-rich ashes are not recycled, despite the technology for doing so now being available. In order to improve the recycling rate, current regulations at national and EU level will have to be critically reviewed. Government recycling incentives may also be helpful.
- Globally, an increasing crop area is available for biofuels and bioenergy. This may stimulate the demand for P fertiliser as well as increase losses through erosion. The principle behind these crops is the prevention of global warming. Whether this is achieved in a sustainable manner will also depend on the degree of recycling of the P-containing residues (back to the land where the crops were

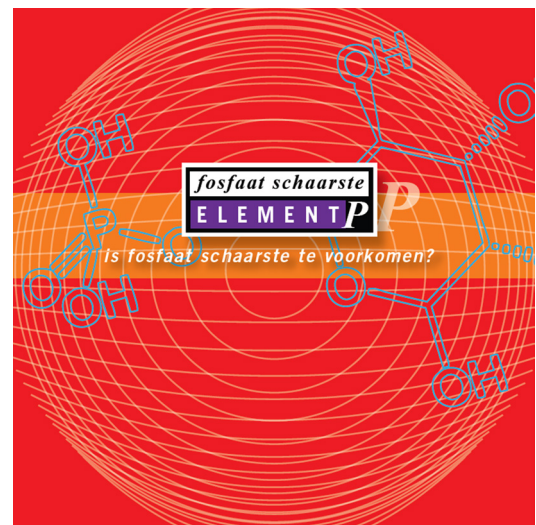
grown). If the Netherlands imports these types of energy-containing materials from other countries, it should return at least the nutrient-containing residues (especially P) to the production site.

🌐 Phosphorus shortage: an opportunity

As long as there is no substitute for phosphorus, solutions to the problem of phosphorus scarcity include improving the efficiency of nutrient management in agriculture, and the recovery of nutrients from waste (water) or manure/human excretions. This means that phosphorus shortage creates opportunities related to the increasing demand for technological innovation in (waste) water technology and recycle industries. Moreover the recovery and trade of nutrients will turn sanitation into a financial sustainable business. See also: www.phosphaterecovery.com.

Documentary

A ten minute movie (in Dutch), entitled 'Element P - fosfaat schaarste: Is schaarste te voorkomen' was made as part of this process. The documentary and accompanying booklet outline the current problems regarding phosphorus depletion, as well as the opportunities from a private sector perspective. The movie can be found on YouTube.



Process output

The 'Phosphorus depletion: the invisible crisis' process included the publication of articles, case studies, a documentary, and a plan for the set-up of a future 'Nutrient Platform'. Two seminars were held (in The Hague and Brussels) to raise political awareness, and the issue was presented at several international conferences (e.g. the World Water Forum in Istanbul, the World Water Week in Stockholm, and the International Conference on Nutrient Recovery from Wastewater Streams in Vancouver).

This resulted in the following publications:

- Research report: 'Phosphorus in agriculture: global resources, trends and development'.
- Case study: 'Phosphorus: an essential but finite resource. Case study for the Netherlands'.
- Policy note and accompanying letter to the Minister of Agriculture, Nature and Food Security (LNV) based on the research report.
- Seminar notes: On the mini-seminars in The Hague and Brussels.
- Draft plan for setting up a Nutrient Bureau.
- Fact sheet.
- Article in The Broker: 'Peak phosphorus. The next inconvenient truth'.
- DPRN process report.
- Documentary: 'Element P – fosfaat schaartste: Is schaarste te voorkomen'.
- Online library with background documents.

All publications are available on the website:

<http://phosphorus.global-connections.nl>

Follow-up

The process was successful in generating new alliances and plans for activities related to phosphorous depletion.

The Nutrient Flow Task Group (NFTG) has been transformed into a Dutch Nutrient Platform (NP). This platform is continuing NFTG's work in close cooperation with key partners like the Global Partnership on Nutrient Management (an initiative of the Dutch and US Governments and UNEP following the 17th Conference on Sustainable Development in May 2010) and the Global Phosphorus Research Initiative, with whom alliances were established during the DPRN process. The Nutrient Platform brings together private companies, NGOs and knowledge institutions with the aim being to create the conditions necessary for sustainable nutrient use. The platform's strategic plan describes the vision and mission of the platform, its purpose and strategy, its learning approach, proposed activities, the organisational structure and funding requirements.

The European Directorate-General for the Environment commissioned PRI-WUR and the Stockholm Environmental Institute (SEI) to perform a desk study of the sustainable use of Phosphorus in 2010. The study focuses on the present and future supply and demand of phosphate in the world, the environmental effects of phosphate use (biodiversity, radioactivity, energy, heavy metals), solutions and institutional requirements.

Development Policy  Review Network

This infosheet was made by DPRN. With a view to stimulating informed debate and discussion of issues related to the formulation and implementation of development policies, DPRN created opportunities to promote an open exchange and dialogue between scientists, policymakers, development practitioners and the business sector in the Netherlands and Flanders from 2003-2011.