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Background

The HELCOM Contracting Parties agreed in the Ministerial Meeting in 2013 to enhance the recycling of phosphorus (especially in agriculture and waste water treatment) and to promote development of appropriate methodology.

The HELCOM Workshop on nutrient recycling in the Baltic Sea countries was held on 27-28 March in Berlin, Germany by Julius Kühn-Institut and HELCOM in cooperation with the European Union Strategy for the Baltic Sea Region Policy Areas Bioeconomy, Hazards and Nutri.

The HELCOM Agri group took note of the suggestions that the workshop prepared for HELCOM and discussed what kind of HELCOM tools can be applied to facilitate P reuse in the region (Outcome of AGRI 4-2017). The group agreed on the need of clear definition for nutrient recycling and identification of the gaps which should be filled with the help of the tools, and agreed that the best way towards recycling of nutrients could be to start with elaboration of strategy and definitions.

The attached document provides background on the importance of nutrient recycling as well as the obstacles and solutions.

Action requested

The Meeting is invited to:

- take note of the attached information on the preconditions for the development of a regional strategy on nutrient recycling,
- support the initiative by HELCOM Agri group on developing a regional nutrient recycling strategy,
- provide feedback on the major aspects to be reflected in the strategy, and
- consider the regional nutrient recycling strategy as a potential topic for the Ministerial Meeting.

Nutrient recycling can help combat the problem of eutrophication

Phosphorus (P) and nitrogen (N) are essential nutrients to the growth of plants and the food production. There are no substitutes for them in animal feed and fertilizer.

Disrupted nutrient cycling is a problem all over the world. Phosphorus and Nitrogen are lost by leakage from different parts of the food cycle. Valuable nutrients are wasted causing environmental degradation instead of being used for plant nutrition. Leakage to waterways and atmospheric diffuse load cause eutrophication of waterways and pollution of ground water. Two main sources of leakage are agriculture and sewage management. Because of the losses from different stages of the nutrient chain only 20–25 % of the mined P-rock ends up in the human food and nutrients from sewage treatment do not end safely and efficiently into the fields.

The nutrients

Phosphorus - an unrenewable resource

In nature phosphorus never appears in its elementary form but is found in an inorganic form (phosphate) in all living cells. It is obtained from phosphate compounds found in sedimentary and igneous rock deposits. The main user of phosphorus is agriculture. Around 95% of global phosphorus production is used as fertilizers, animal feeds, and chemical pesticides. The intensification of agriculture especially in the developing countries increases the demand for phosphorus at a rate of 5-6% per year. There is a lot of volatility in the phosphorus rock prices - in 2008, prices of phosphorus rock rose by 700% in a little over a year, contributing to increases in fertilizer prices.

The global phosphorus resources are limited and situated in geopolitically delicate areas. In the EU there are only small raw phosphate reserves, the biggest producers are Morocco, China and the USA. EU has added phosphorus on the list of critical raw materials in 2014.

Nitrogen - a key input in increasing plant productivity

As gas, N2 constitutes 78 % of the earth´s atmosphere. However, as such N2 is nearly unavailable for crop nutrition with the exception of legumes´ capacity to fix atmospheric N2 biologically. Out of other nitrogen compounds nitrates and ammonium are plant available. They are normally scarce in natural environments limiting crop productivity.

Ammonia is the key intermediate product in the production of all nitrogen fertilizers. In 2009 up to 152,9 million tons of ammonia was globally used to the production of ammonium nitrate (AN) and nitrogen, phosphorus and potassium containing NPK fertilizers. Fertilizer producing processes use large amounts of fossil energy, mainly natural gas. China is the largest ammonia producer followed by the EU 28.

Sources of recyclable nutrients

Manure

Livestock manures represent by far the largest source (76 %) of recyclable P in Europe (ca 1, 8 million tons of P per year). The modern agriculture where crops and livestock are mainly produced in different areas has led to a situation where the use of P across Europe is very unbalanced; there are farms and regions where the use of too little P is compromising agricultural output, while there are other more intensive farms and regions where the overuse of P is continually building up P levels in soils with increased long-term eutrophication risk.

Nutrients in waste water and sewage sludge

Currently, the P is recovered and recycled from wastewater mainly as compost and sludge. A major leakage of N from the nutrient cycle occurs in the currently dominating urban waste water treatment system where reactive nitrogen compounds are removed by nitrification and denitrification back to nitrogen. The process wastes the energy used to produce reactive nitrogen compounds for fertilizer use. An ambitious long-term goal should be to recycle reactive nitrogen compounds from wastewaters utilizing new sewage management technologies. Future sewage processing systems should be designed to recover N, P and C for re-use as fertilizer, rather than wasting a reactive N resource through denitrification and carbon through activated sludge treatment.

Solutions

Market for cleantech and new organic fertilizer products

The large volumes of manure generated in relation to the available land are in some regions a major barrier for sustainable recycling. Organic sources of phosphorus and nitrogen are often heavy and voluminous materials that cannot easily be transported over long distances.
However, supplies could be better distributed at the regional level, and the availability and quality could be improved by further processing.

There is a market for developing new organic fertilizer products. The challenge is to produce fertilizers, which are competitive in price, easy to use with present equipment and preferably tailor-made for the specific needs of different plants. The renewal of the EU Fertilizer Regulation will pave way for European markets for organic fertilizers. We also need new innovative logistics to connect those with excess nutrients with those, who can use them. The solutions are information intensive and based on digital systems.

Sewage sludge handling practices vary considerably between countries, as well as the understanding of the need to recycle phosphorus. Handling practices depend on the economic situation, availability of phosphorus in the market, size of the waste water treatment facility, applied technics, quality of sewage sludge and waste water management. The technology to recover P should be considered as a part of the whole technological cycle of waste water treatment taking into account also waste water and consequently sewage sludge quality, sewage sludge treatment, method of P removal from waste water, energy consumptions as well as geographical and economical characteristics of a particular area.

Digitalization

Digital technologies will have a key role in developing nutrient recycling. Precise knowledge of the nutrient needs of different plants is the starting point. Tailor-made fertilizer products offer great potential for yield improvements. Precision equipment for spreading the fertilizer, based on crop and soil needs in various parts of the parcels, will improve nutrient use efficiency and reduce nutrient leaching to the waterways. Part of the excess nutrients can then be caught with catch crops and soils protected with plant cover during wintertime will prevent nutrient loss through erosion. Digital technologies will also have a role in planning the animal feeding that will influence the nutrient amounts in manure.

Summary

Nutrient recycling is an integral part of an efficient food system and a good example of circular economy. Nutrient recycling aims at optimal use of nutrients in plant production, securing that nutrients while passing the whole food chain from food and feed to food processing, retailing, consumption and waste management are in the end returned back to soil for plant production - and the circle begins again. All sources of waste from different parts of the circle are minimized as well as an introduction of the new nutrients to the circle. This leads to decreased nutrient leaching to the Baltic Sea and makes a significant contribution to solving the eutrophication problem.