CO-CREATING WATER PROTECTION: A SUCCESS

The University of Helsinki, Finland, explores gypsum as a solution to phosphorus loads from agriculture reaching the Baltic Sea, in collaboration with farmers and other stakeholders

The Baltic Sea is the most polluted sea in the world, suffering from eutrophication due to nutrient loads from industrial and municipal point sources, as well as agricultural non-point sources. The hardest challenge is to reduce loads from agricultural fields. In Finland, a unique union of scientists and local farmers is currently examining a new and promising solution: gypsum application to arable fields. In a large-scale experiment, gypsum has proven to be an efficient, socially acceptable and environmentally sustainable new measure to reduce the loss of phosphorus.

The promise of gypsum

When applied to arable fields gypsum may reduce up to 60% of particulate phosphorus and 30% of dissolved phosphorus loads, which is around 50% of the total phosphorus.

Once spread on fields, gypsum increases the ionic strength of soil, creating larger aggregates of soil particles and affecting phosphorus binding, which decreases the phosphorus losses to waterways. The soil structure improves, erosion decreases, and phosphorus remains available for plants. These beneficial effects occur immediately after the dissolution of gypsum and last for several years, all achieved without any loss of crop yields. The average gypsum dose per hectare is four tonnes.

Fig. 1 Farmer Martti Hyssälä was eager to test gypsum on his fields for the good of the Baltic Sea

Markku Ollikainen

Gypsum for the Baltic Sea region

The HELCOM Baltic Sea Action Plan requires an annual reduction of 15,000 tonnes of phosphorus in order to achieve the good environmental status of the Baltic Sea. While point sources provide the greatest reduction potential, a reduction of 3,000 tonnes is needed from agriculture.

Gypsum treatment can provide a solution to agricultural phosphorus loading in the entire Baltic Sea, and gypsum treatment may be suitable for use in Sweden, Denmark and Poland. Together with Finland, the annual agricultural phosphorus run-off to the Baltic Sea from these four countries amounts to 8,000 tonnes. Gypsum treatment of fields could reduce the load by up to 1,500 tonnes from these countries alone, amounting to 50% of the above-mentioned reduction need for agriculture. The potential in gypsum is therefore huge.

A large-scale pilot as the social experiment

To examine the phosphorus reduction potential, economic viability and social acceptability of gypsum, a large-scale research pilot is taking place in the Savijoki River Basin in southwest Finland. The SAVE project (Saving the Archipelago Sea by applying gypsum to agricultural fields) is carried out in co-operation between natural scientists (Finnish Environment Institute) and environmental economists (University of Helsinki). SAVE is a key project of the Finnish government funded by the Ministry of Environment. Serving as a case for the NutriTrade project, which aims to establish a Baltic-wide nutrient offset platform, the gypsum pilot also receives funding through the EU's Interreg Central Baltic Programme.

Co-operation with farmers and other stakeholders is important. The pilot project creates an open collaborative working environment and welcomes farmers' experience and knowhow to further develop all potentials of the gypsum concept. Local farmers, as well as producers of gypsum, traders, scientists, NGOs, public authorities and other stakeholders, contribute to improving the solution. The experience created during the pilot project will help to compile a plan for gypsum treatment across coastal Finland.

Experience from the pilot area: the Savijoki River in the municipality of Lieto

The Savijoki River catchment area is ideal for a large-scale pilot due to its size and to the facts that most of the fields are located on clayey soils, there are no lakes in the catchment, and the characteristics of the area are well known. Also, from very early on, local farmers were positive about the pilot. The municipality and its farmers wish to show an example to all farmers in the Baltic Sea region.

Farmer Martti Hyssälä, who took part in the pilot, considered the method very easy thanks to existing machinery and well-organised logistics. Having a chance to work actively for water protection also delighted him: "For a farmer, protecting Nature is a point of honour. It is vital to see beyond our own actions since we are dependent on Nature, and to be able to do this in a profitable way for the farmer. Gypsum is the way to reduce erosion and improve soil structure in the fields where chemical maintenance is needed."

Monitoring the Savijoki River

In the autumn of 2016, gypsum was spread on the fields located in the middle reaches of the Savijoki River. Almost half of the arable fields, over 1,550 hectares, were treated with gypsum. The upper reaches were left as a control area where gypsum was not used and long-term water quality measurements based on continuous online sensors and manual water sampling takes place. We have two measurement sites in the middle reaches of the river in the treatment area (Fig. 2). They are instrumented similarly to the upper reaches.

Impacts on water quality are visible to the eye

After the gypsum was spread, a promising pattern emerged in the pilot area: water clarity increased and the turbidity and concentration of particulate phosphorus decreased relative to the control area. Referring to Fig. 2, the lowest concentration was found in the lower site of the gypsum pilot area. Indeed, some farmers told us that they had never seen the water so clear.

Between November 2016 and March 2017, the lower site measured 26% less particulate phosphorus in total compared to the control site when taking water volumes and the sizes of the run-off areas into consideration. What is more, only 43% of the fields running to the lower site have been treated with gypsum. This implicates a reduction of 60% in particulate phosphorus from the fields that have been treated with gypsum.

What say aquatic biota and soils?

We have a huge package of analysis on the impacts of gypsum treatment on aquatic biota and soils. Soil tests are underway and in the autumn we will test the impacts of sulphates on trout. We have results on how sulphates loads from gypsum impact adult thick-shelled river mussels: the temporary maximum sulphate concentration 470mg/l (average 32mg/l) had no effect on them. The same finding applied to common water moss.

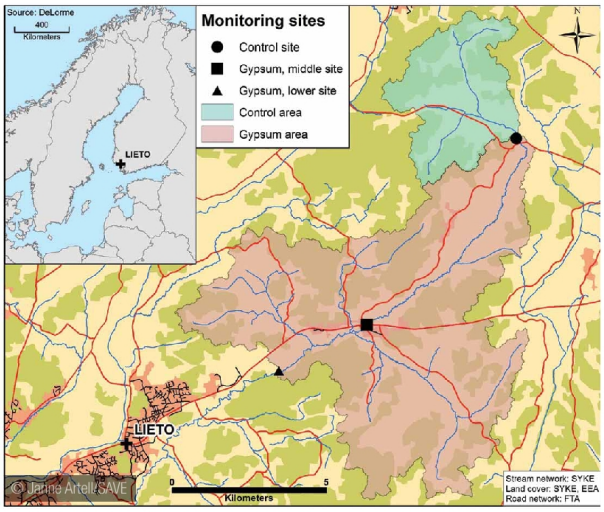

Fig. 2 The treatment area, the control area, and the three monitoring sites along the Savijoki River

Positive feedback from the farmers

The survey conducted after the spreading of gypsum on fields shows that farmers have highly positive experiences from their participation in the pilot. A large majority (77%) supported the introduction of the gypsum treatment into the mix of agri-environmental measures. Just over half (56%) considered the gypsum treatment as an easy measure, and no more than 4-21% reported problems (and solutions) in various work phases (delivery, storage, internal carriage on the farm, spreading, scheduling with other work in fields).

Farmers recommend gypsum – and so do we

Apart from the actual spreading of gypsum, the participants warmly recommend the pilot project and encourage other farmers to take part in similar ones. A large majority (between 67% and 83%) were of the perception that their opinions had been heard and they had an impact on the development of the gypsum concept towards a new agri-environmental measure.

We are happy to help organise similar pilots in other Baltic Sea countries.

Please see the previous article of the research group in "Co-creating water protection" in *Pan European Networks: Science and Technology* 21, pp.214-215, http://www.paneuropeannetworkspublications.com/ST21/#214

SAVE GOVERNMENT KEY PROJECT NutriTrade EUROPEAN UNION European Regional Development Fund Interreg Central Baltic

Markku Ollikainen
Professor of Environmental and Resource Economics
Department of Economics and Management
University of Helsinki

+358 294158065

markku.ollikainen@helsinki.fi
www.helsinki.fi/taloustiede/opiskelu/yle/ollikainen/
http://blogs.helsinki.fi/save-kipsihanke/
http://nutritradebaltic.eu/