Within the project “Living coast” several measures have been implemented around the heavily eutrophic bay Björnöfjärden in the Stockholm archipelago. Efforts have been made both in water and on land. One of the land based measures was carried out in 2014 on the arable land at Säby farm on Ingarö, located in the catchment area of Björnöfjärden. The aim was to reduce eutrophication of the bay by reducing the leaching of phosphorus from nearby arable land. This was done by so-called structure liming. The local farmer Mikael Windahl and Emil Rydin, limnologist and project manager at BalticSea2020, have supervised the structure liming in the fields and are now monitoring its effects, both on the crops and the bay.

Liming is a common method for maintaining pH balance in arable land which makes the crop absorbs nutrients more effectively. Structure liming is a measure that is suitable for clay soils - it raises the pH level and at the same time improves the soil structure.

Clay soils consist of a high proportion of very fine particles, which means that the soil can be packed tighter than soils consisting of a larger amount of big particles. Well-packed clay soil can make it difficult for the plant roots, water and nutrients to pierce the soil and the risk for nutrient leaching is therefore high. When the water can not penetrate the soil, it is diverted away from the farmland bringing nutrients - phosphorus – with it to the groundwater and ditches, instead of benefiting the crop. The harvest will deteriorate and the nutrients that are led away by the water contribute to eutrophication when it reaches lakes and seas.

Soil with a good structure is, in contrast to tight packed clay soils, more porous which makes it easier for the crop roots to reach deeper into the ground. The soil becomes more easily cultivated, have higher permeability and holds water better. And above all, a good soil structure increases the soil’s ability to retain nutrients, which means that the risk of nutrient leaching decreases. When the soil can keep the nutrients there is a lesser need of additional nutrients such as mineral fertilizers.

Nature has its own structure-building processes, for example desiccation cracking,
cracking due to freezing and the presence of organic material. But sometimes these processes are not efficiently enough, especially in dense clay soils, making structure liming a very effective measure.

Quicklime or hydrated lime (quicklime with added water) is used in structure liming. Successful results require that the soil contains clay because lime reacts with the clay. When the clay particles are saturated with calcium ions they lump together at the same time as the base saturation in the soil increases, and when the base saturation increases, the soil becomes less acidic.

The reaction between the clay particles and calcium ions happens immediately when mixed. But it is only the clay surface that comes in direct contact with the lime that changes structurally. A good mixture is therefore crucial for the long-term outcome.

Within the project “Living coast” farmer Mikael has treated approximately 30 hectares of arable land with financial support from BalticSea2020. The structure liming was done during autumn 2014.

- Structure lime is spread with a normal lime spreader. The lime has to be mixed into the soil within 12 hours which is done with, for example, a cultivator. You need to work through the soil with the cultivator about 3 times at a depth of 25 cm

And the work paid off!

- Immediately I saw the results in terms of better soil structure. The main advantage of the treatment is more consistent and higher yields, says Mikael.

**Before and after.** The structure of the clay soil is very compact before structure liming is done. The clay particles form a “brick wall” making it difficult for water and roots to penetrate the soil. The harvest decrease and the water, together with nutrients, will run off the farmland to the groundwater and ditches. After carrying out structural liming the “brick wall” has been broken-down and the soil is more porous. The soil holds water better and nutrients (small circles) remaining in the ground.

Photo: Ida Mårtensson
Clay soil treated with structure lime.
But there is a downside to structure liming. It is expensive.

- For me, as a tenant farmer, I would not consider it feasible without financial support of around 50 % of the total cost, says Mikael.

Structure liming should be a measure that is worthwhile for the farmer in the long run, because a successful structure liming lasts for decades and the nutrients that are added to the field are absorbed by the crop much more effective when the soil has a good structure. The cost to implement the measure in comparison to its benefit is something that is examined by Emil Rydin, project manager at BalticSea2020.

- By measuring phosphorus leaching from the field before structure liming and after we get an estimate of the environmental benefit of implementing the measure, says Emil.

- We also carry out other measures to see how much phosphorus leaching can be reduced from Säby farm’s agriculture activities. We have established a two step-ditch, a sedimentation pond with limestone filters and a dip ditch with lime mixture. The runoff water from the field has to go through this before it reaches Björnöfjärden. Along with the structure liming, we hope to reduce the leaching greatly. Moreover, we will get answers to whether the measures are actually feasible versus the expenditure involved, important information for all organizations, farmers and authorities working to improve water quality in lakes and seas, says Emil.

The results are not compiled yet, but in early 2017 the results from all the measures will be presented in a white paper.

So far SLU’s experimental fields shows that clay soils treated with structure liming can decrease the phosphorus losses with up to 50 %.

Today, farmers can get local water conservation grants for structure liming. Read more on your county administrative board’s LOVA page.

To read more about the measures done within the project "Living coast", visit our website www.balticsea2020.org or click here.