

## Work Plan on gypsum application

Altogether, the results from pilot gypsum were very positive. They encourage us to think that the method is feasible for large scale application and acceptable from farmers' point of view. This work plan describes the development work of the method in order to enable its implementation in a large scale with public support in Finland, and possibilities to export the concept in other countries in the Baltic Sea region.

### 1. Examining potential land areas for gypsum application

Building up a plan for large-scale gypsum application begins from examining potential land areas in Southern Finland. The work concentrates on the catchment areas of the Archipelago Sea and the Gulf of Finland and the southernmost part of the catchment area of the Sea of Bothnia. The focus is primarily on clay soils, since gypsum application is known to work well in these type of soils. Suitability of land areas to gypsum treatment depends also on other features of the soil and environment, which must be taken into account. For instance, acid sulphate soils are excluded for gypsum application. In order to avoid environmental risks, ground water and lake catchment areas, as well as Natura protected areas and ground water depended ecosystems will be excluded when determining the potential land areas. This work requires spatial data and expertise and it is done by Finnish Environment Institute as a part of project SAVE.

Furthermore, the pilot in Savijoki shows that the feasibility of the gypsum application may also depend on local conditions, which may not found out from SYKE's data. How these aspects could be taken into account will be discussed with the regional and local environmental authorities who are responsible of assessment of environmental risks.

In addition, there may be some farm or even parcel level restrictions for gypsum application, such as the location of the parcels, soil conditions and cultivation practices. Therefore, it is likely that some part of the theoretically potential land area should be excluded for these practical reasons. This uncertainty have to take into account in estimation the total land area feasible for gypsum application.

### 2. Investigating options for gypsum supply chain

In the pilot, gypsum was transported from Yara's factory in Siilinjärvi to farms by full-trailer trucks with 40-50 tons loads. It was the most competitive way, since the trucks could be loaded and weighted in Siilinjärvi, driven directly to the pilot area and unloaded at the site where gypsum were spread. The capacity of truck transportation was sufficient in this pilot's scale but it would not be sufficient for larger scale. Thus, other options for transportation have to be considered. One possible solution is to establish temporary storages for gypsum to serve local or regional demand. Gypsum could be transported to the storages in larger cargos using train or ships, or using trucks outside the harvesting season. Local operators could deliver gypsum to farm, when the distances are short. The options for gypsum transportation should be open also for other gypsum suppliers and sources, which is important also from the perspective of conceptualisation (see step 6).

Different transportation options and combinations will be investigated and compared with logistics companies, gypsum suppliers and agricultural supply stores. Questions to be solved are how to manage the time frames and costs, who is responsible of the coordination of the delivery, how to prepare to demand peaks and uncertainty of demand due to weather conditions.



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### 3. Policy brief for large scale application

Policy brief (Deliverable 5.8.1) provides an overview on how the large scale application could be operated in practice. Based on the results in the steps 1 and 2, the policy brief describes the potential land area in Southern Finland for gypsum application, and options how the transportation of the gypsum could be managed. The policy brief provides also an estimation on how large phosphorus reduction is achievable within the plan.

### 4. Examining preconditions for large scale application plan by public sector

Including gypsum application to the Finnish agri-environmental support scheme or other possible schemes requires careful examination of all possible influencing factors. Implementing a large scale application on national level and public support raises questions that have to be discussed with experts of support schemes and other relevant stakeholders, such as Ministry of Environment, Ministry of Agriculture and Forestry, Agency for Rural Affairs, ELY-Centres, agricultural producers' organisations and research institutions.

An essential actor in the pilot was the coordinator, being responsible of the overall management. The coordinator acted as a communicatory centre leading the pilot forward. The coordinator recruited the farmers to the pilot, created an agreement form and provided instructions on gypsum application, educated an agent to perform the farm negotiations, planned logistics together with supply chain and managed the financial flows. In the gypsum application agreements it was defined, which parcels will be treated with gypsum, and how the work and occurred costs were compensated. This information enabled to manage the pilot within the set budget and carefully plan the logistics.

On national level, a key question is whether large scale spreading is organized: as a centralised (national or regional) or decentralised level (by farmers and agricultural supply stores).

If a management authority is leading the spreading, it receives the coordination's position. However, the tasks and responsibilities are now more extensive and complicated than in the pilot. The responsibilities on e.g. communication, guidance, management of farmers' applications and acceptance of the parcels for the treatment, monitoring and subsidy payments should be discussed. One additional question is, to what extend the management authority should communicate with the gypsum supply chain (private sector) which need time for preparing for the large scale operations.

For the decentralised solution, the option to be examined is to follow the way the Finnish Agri-environmental Program is organised. Thus, farmers would make an agreement concerning the field parcels they wish to apply gypsum with the Ministry of Agriculture and Forestry, which provides monetary compensation. Farmers order the amount of gypsum using their own agricultural supply stores, which deliver gypsum to farmers. Farmers take care of spreading. In case agricultural supply stores and the gypsum seller wish to make organisational solutions to facilitate flexible and low-cost deliveries, they may organise local temporary storages. For the decentralised option, the tasks and responsibilities mentioned in the case of centralised option would be, at least to some extent, divided between the stakeholders.

Both in the centralised or decentralised system, the practical questions which farmers will face are how the feasibility of certain parcel for both gypsum application and suitability to the support scheme can be checked. In the pilot these issues became clear in negotiations between the farmer and an agent

representing the coordinator. The agent provided the information on the boundaries of the pilot area within the parcels could be selected, and the feasibility of the each parcel were checked using soil analysis data. Discussion on how to manage these issues will focus on e.g. the need of advisory services, farmer training and digital tools.

The conditions and structure of the support scheme would define possible allocations and prioritisations concerning the land areas to be treated with gypsum. However, including gypsum application to the current support schemes may require many modifications. The most critical issues that should be examined, are related to the gypsum's relationship to other supported water protection measures, and the time frame and cost structure of gypsum application. Costs of gypsum application consist only of the implementation costs, since it does not require any maintenance, although the impact lasts for several years. The costs are allocated to a certain time point, which also cause a liquidity problem for farms. From practical point of view, the gypsum application would require a flexible system in order to delay the gypsum application to other year since the weather conditions may be an unpredictable hindrance for implementation.

#### 5. Policy brief for including gypsum to Finnish agri-environmental support scheme

As the Policy brief on large scale application focuses on the operational phase, the policy brief for including gypsum to Finnish agricultural support scheme (Deliverable 5.9.1) provides discussion on how the coordination and the financing of the large scale application could be realised. The policy brief is based on the results from cross-sectoral discussion described in the step 4.

#### 6. Conceptualisation of gypsum treatment

While the work in steps 1-5 focuses on gypsum application in Finland, step 6 examines the method from a wider perspective, as a concept, which could be exported to other countries in the Baltic Sea region. Since the method is rather new, there are many questions concerning the feasibility of gypsum application in other countries. They cover issues like in which countries gypsum application would be feasible, what would be the local preconditions, the social awareness and acceptance, by whom it would be coordinated and financed and are there local sources for gypsum. The questions are partly similar than the Pilot gypsum is aiming to solve.

Identifying all possible sources of gypsum is an important task, especially, if the concept is applied to other countries in the Baltic Sea region than in Finland. Phosphogypsum produced by Yara is one type of gypsum. Gypsum is produced also in flue-gas sulfurization process in energy utilities and other industrial processes, but it can also be mined as a natural mineral or recycled. However, the feasibility of other sources of gypsum for agricultural and water protection purposes requires not only analyses to guarantee the content and safety of the gypsum product but also verifying the effect on the soil and water quality, which are not part of the work in this project, but may rise discussion and interest for new research projects.

The concept is developed by presenting the example from the gypsum pilot and discussing the method and lessons learned with international stakeholders, such as agricultural, soil and environmental scientists, economists, possible gypsum suppliers, water protection associations and other NGOs. These target groups are met in international events and personal meetings.