SUMMARY OF REGIONAL NUTRIENT MANAGEMENT PLAN FOR SOUTHWEST FINLAND

Sustainable Biogas
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ELY-CENTRE FOR SOUTHWESTERN FINLAND

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SUSTAINABLE BIOGAS

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1.SUBJECT, CHALLENGES AND MEASURES

1.1 Subject

This nutrient management plan has been developed as part of the Sustainable biogas project funded by the EU Interrag Central Baltic programme. The aim of the project is to promote the sustainability of biogas production from the point of view of water protection and to reduce nutrient leakages related to biogas production, considering the production of organic biomasses, processes in the biogas plant and the use of nutrient-rich digestates and other end products. This plan presents practical means and development proposals for the management of nutrients through biogas production in southwestern Finland.

Treatment of biomasses in accordance with the principles of the circular economy, are seen as an important part of improving water status. The load of nutrients on the water is the most common cause of deterioration of water quality in our area. Excess nutrients increase the eutrophication of waters, change the aquatic ecosystems, and the usability of water bodies getting worse due to overgrowth and the increase of harmful, even dangerous algae.

According to the studies, in many areas in south-western Finland, more organic matter containing nutrients suitable for field fertilization is formed than would be needed in area. For example, large amounts of manure are formed in livestock production areas, which as such would be suitable as arable fertilizer, but there is no need for excessive use of manure, and on the other hand, crop production would have a need for organic fertilizers and soil improvers. In addition to the energy obtained from biogas production, it is possible to bring together various biomasses for processing so that they can be used, for example, as agricultural fertilizers and industrial raw materials. Ideally, biogas production can direct nutrient-rich biomass to areas where there is a deficit of nutrients. At worst, nutrients concentrated in biogas production form areas of nutrient surplus or exacerbate existing ones.

Efficient nutrient recycling reduces dependence on non-renewable and energy-intensive mineral fertilizers. The need for and demand for recycled fertilizers has increased due to the availability and price fluctuations of industrial mineral fertilizers. In addition, there is an increasing demand for sustainable biogas energy in both heat and electricity production or as a transport fuel. Biogas production and nutrient recycling play an important role in security of supply issues.

1.2 Challenges of nutrient management

Biogas will replace even more fossil fuels in the future. The positive effects of biogas production on climate change mitigation are undeniable. The effect of increased production on the regional distribution of nutrients has received less attention. Nutrient-rich biomass can be collected from a large area, especially in large, separate biogas plants. This becomes problematic when the digestate of the plant remains only in the area around the plant, which can lead to the nutrient requirements of the crops being exceeded. Excess nutrients run-off the soil into the waterways, eventually ending up in the already eutrophic Baltic Sea. The situation is also not favourable for society, as we are wasting valuable nutrients which should be utilized in cultivation.

The challenges of nutrient management are largely related to the underdeveloped market for digestate-based recycled fertilizers. There is more supply than demand due to their poor price competitiveness compared to mineral fertilizers. Supply and demand often do not meet in the same geographical area, and digestion usually occurs where there are already sufficient nutrients. Lack of demand means that finding end users can be difficult. From the point of view of the nutrient balance, it would be ideal for the digestate to be transported from the surplus area to the deficit area. However, transporting wet digestate over long distances is not very cost-effective, and further processing the digestate into a more transportable form can increase the price differential relative to mineral fertilizers. There is a risk of stockpiling and over-fertilization of fields to get rid of digestate, in which case the regional nutrient balance may not be sufficiently taken into account.

The legislation does not yet recognize the problems of nutrient management very well. In EIA and permitting processes regional nutrient balances cannot be taken into account in the construction phase of plants. Biogas plants built in surplus areas can source raw materials in deficit areas, further distorting the nutrient situation. Regarding to the spread of digestate, environmental authorities may require sufficient arable land for on-farm biogas plants, but this is not the case for other biogas plants. Other, separate biogas plants do not have to consider the regional nutrient balance when looking for end users of digestate. Limitations in the legislation increase the risk of over-fertilization of fields. Pressure to break away from fossil fuels has led to insufficient attention being paid to nutrient management issues in biogas plants in policymaking.

1.3 Measures

In order to prevent risks, the authorities should consider the regional nutrient balance when designing and granting permits for biogas plants. Useful tools are, for example, nutrient maps (figures 1 and 2), which show the location of nutrient surpluses and deficits at the local level. The nutrient map data should be used to plan the allocation of environmental subsidies, in order to direct biomasses to areas where there they are most needed. Regional nutrient situation should be monitored regularly, and maps need to be refined and updated as the nutrient situation changes in time and space.

Cooperation between public authorities and those working in the biogas sector is a key point. It is the responsibility of the authorities to ensure that existing legislation is complied with and, in addition, to ensure that those working on biomass are aware of the regional nutrient balance. Although legislation and new controls are being developed and, for example, a nutrient cycle compensation for biogas plants is still being prepared in 2022, creating incentives for the transport of nutrients from surplus to deficit areas, more measures are needed to provide authorities with better tools for nutrient management. For example, 1) nutrient recycling targets could be included in the building permit procedure and 2) investment aid could include a condition for a digestion utilisation plan.

The market for digestate-based recycled nutrients needs to be developed to be a realistic alternative to mineral fertilizers. The transfer of nutrients from the surplus area to the deficit area should be supported, for example, by developing more detailed action plans with operators, and by supporting projects that create practical conditions for the transfer of nutrients. Further processing of digestate into a more compact form may encourage its transport over longer distances. Regional nutrient imbalances can also be prevented by good location planning for biogas plants. A biogas plant built in a deficit area can alleviate the nutrient deficit in the area by collecting biomass from the surplus areas.

In the future, nutrients must be seen as a valuable natural resource whose recycling rate must be able to increase. This means raising awareness of nutrient management in the biogas sector but also in society at large. For example, training and information can ensure that biogas plant operators and others working with biomass understand the importance of good nutrient management. In society at large, for example this may mean clarifying the importance of bio-waste recycling. The separate collection obligations for bio-waste that is coming into force is not enough, but the efficiency of recycling also depends on the enthusiasm for recycling.

The aim of this nutrient management plan in Southwest Finland and it’s measures, is to increase the recycling rate of nutrients, increase self-sufficiency and reduce the nutrient load on water bodies.

1.4 General recommendations in brief

- The nutrients must be balanced between regions to avoid a situation where valuable nutrients are detrimental to their producers or end users and not beneficial.
- At the end of the production chain, the nutrients from the digestates or from biomasses must be recycled, either to fields as nutrients or to industry, for example, as raw materials for organic fertilizers.
- Awareness of nutrient management in biogas production needs to be raised.
- To avoid the risk of nutrient leaching, the use of nutrient products in agriculture must be based on the need of plants and the timing of crop needs. To avoid overall losses of nutrients, digestate should not be applied when there is no or very limited crop uptake.

- The processing of digestate further should be promoted, especially in biogas plants where there is no sustainable use of nutrients as fertilizer nearby. Processing the digestate into a more concentrated form reduces transportation costs.
- Creating markets for digestate would enhance nutrient management, as a lack of demand and finding end users for digestate are often costly and time consuming, especially in areas with nutrient surpluses.

2 NUTRIENT MAPS

The amounts of organic nutrients (nitrogen and phosphorus) formed in the region of southwestern Finland (Southwest Finland and Satakunta) and the phosphorus uptake potential of the fields were mapped as part of the Sustainable biogas project. The survey was carried out in geospatial data format. The maps show the regional nutrient situation in the 5 x 5 km grid area from manure from farm animals, municipal sludge, organic industrial waste (including fish processing plants) and sludge, household biowaste and agricultural crop waste. Due to incomplete data, the maps presented here are for guidance only. They tell us about the most important thing for nutrient management, 1) where the most organic nutrients are produced, 2) where more phosphorus is produced than is needed in arable farming and 3) where there is a lack of phosphorus in arable farming. The phosphorus balance must be balanced between regions in order to avoid a situation where a valuable nutrient is detrimental to their producers and not beneficial.

Two calculation methods were used. In the VE1 calculation method, the phosphorus surplus and deficit areas were calculated based on the needs of the plants, and in the VE2 calculation method, the areas were calculated based on the commitment conditions for environmental compensation.

The largest areas of phosphorus surplus are concentrated in the vicinity of large municipal wastewater treatment plants or food processing plants, as well as in areas with large numbers of farm animals (figures 1 and 2). The largest surplus of phosphorus, 224 tonnes calculated according to calculation method VE1, and 223 tonnes calculated according to calculation method VE2, occurs in the area of the city of Turku, where Kakolanmäki wastewater treatment plant is located. Phosphorus deficiency is most prevalent in areas, where arable farming accounts for the largest share of land use.[1]

Sources

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[1] More about nutrient maps: Update of nutrient maps in south-west Finland as part of the Sustainable Biogas project (Vahanen Environment Oy (2021). (in Finnish)

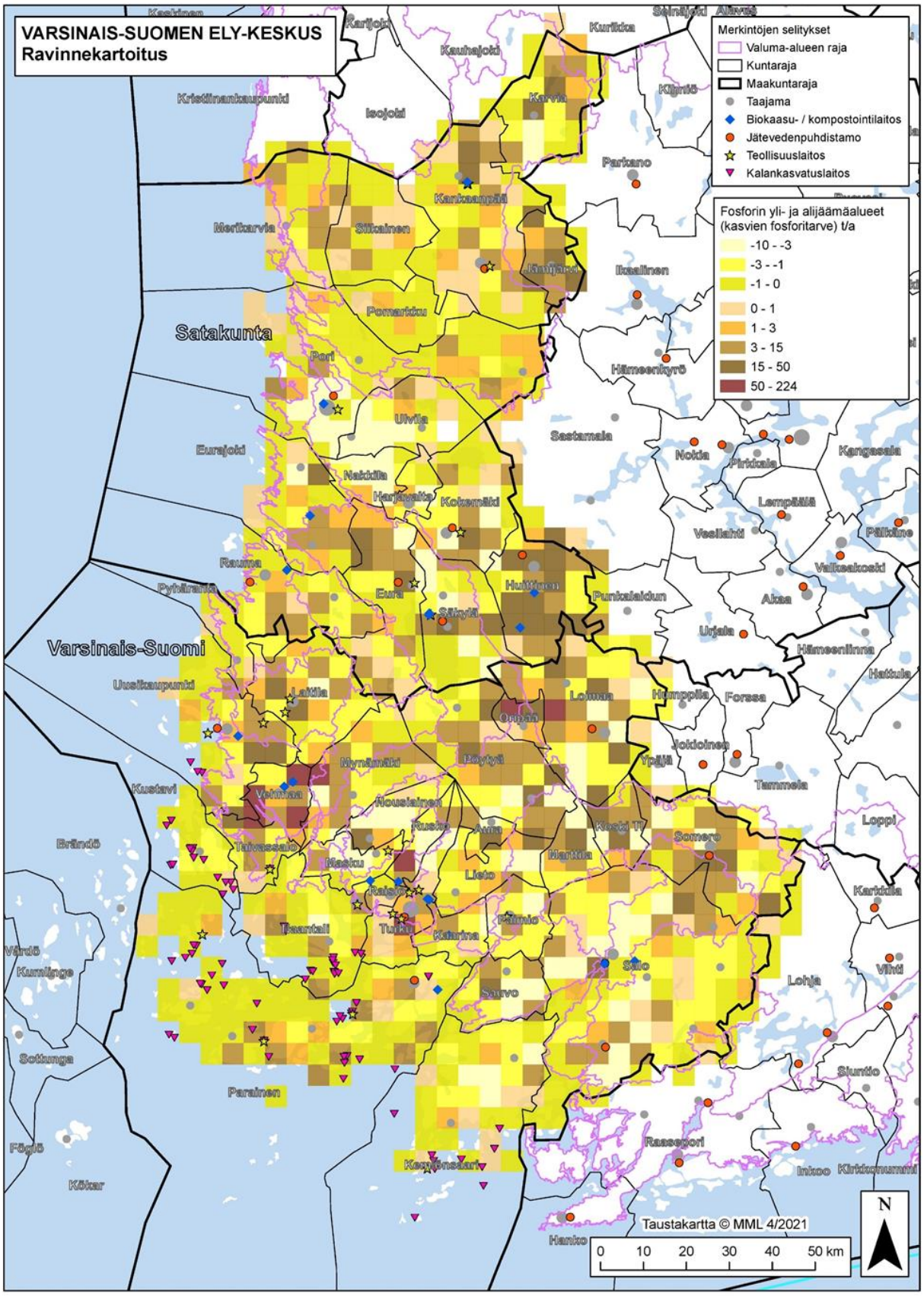

Figure 1. phosphorus surplus and deficit areas based on plant phosphorus demand (Calculation method: VE1) (Vahanen Environment Oy 2021).

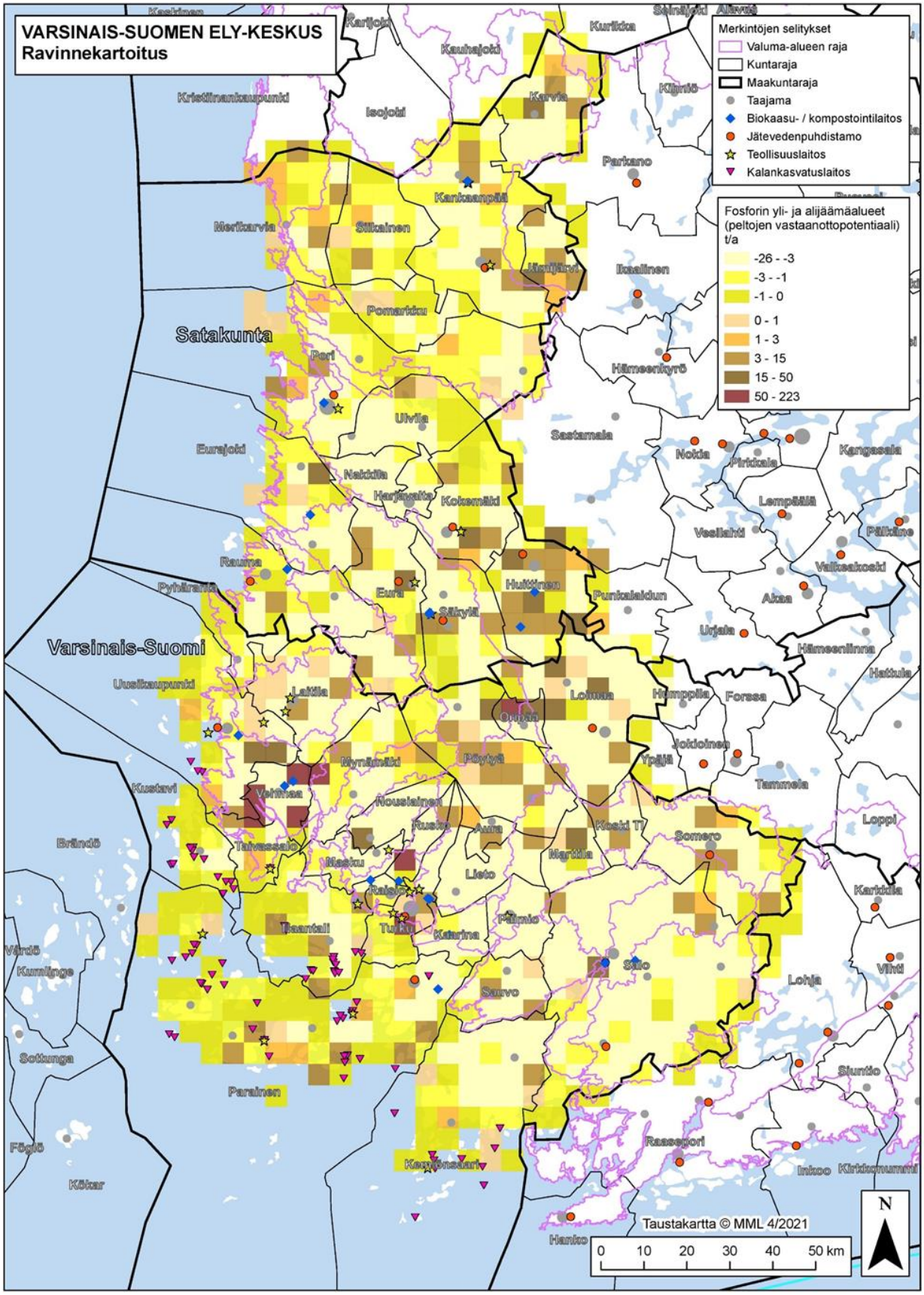

Figure 2. phosphorus surplus and deficit areas based on the commitment conditions for environmental compensation (Calculation method: VE2) (Vahanen Environment Oy 2021).

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The Sustainable Biogas project worked together with the biogas sector and various stakeholders to reduce nutrient discharges from the whole production chain of the biogas production: from the handling of raw materials to the production and to the safe utilisation of nutrient-rich digestates.

According to the results of the project, sustainable nutrient management in biogas production requires careful consideration when planning, permitting and operating the biogas facilities so that the regional nutrient balance is considered, storages for the feedstocks and digestates are adequate and appropriate, and digestate application is based on the plant needs.

Improving the quality of recycled nutrients and promotion of their use are needed. In addition, the reconciliation of the partly contradictory objectives for sewage sludge management - pollution prevention, nutrient recycling and climate change mitigation - should be continued.

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