Saaremaa municipality recommendations: Implementing the Green Network at the local level

LIFE Viva Grass project (LIFE 13 ENV/LT/000189)

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Tartu 2018

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1. INTRODUCTION

Grasslands play a key role within green networks. Specifically, less intensified grasslands such as permanent and semi-natural meadows are characterized by a high provision of *regulation and maintenance* Ecosystem Services (hereinafter "ES") related with *pollination*, the *maintenance of habitats* for key species or *global climate regulation* through carbon sequestration in vegetation and soils (**see table 2**). The provision of multiple ecosystem services ES, understood as multifunctinonality, highlights the role of semi-natural grasslands as relevant elements of the Green Network of Estonia.

The present report aims at:

- Summarizing the extent and conservation status of grasslands in Saaremaa Municipality.
- Assessing the extent, conservation status and supply of ES **within** and **outside** of the current Green Network of Saare County (hereinafter GN).
- Proposing scenarios for the inclusion and protection of grasslands in the GN by implementing the County level GN in the Saaremaa Municipality general plan.

Saaremaa Municipality is contributing to the development of the integrated planning tool from the local government perspective and will test the tool by implementing it through its strategic planning processes, specifically by integrating the tool outputs in the drafting process of the GN in the General Plan. The main interest of Saaremaa Municipality is to preserve its nature values and to gain more knowledge on grasslands' economic growth potential for the local society.

1.1 Overview of grasslands' extent and management status in Saaremaa Municipality

Table 1 contains a summary of the extension of grasslands and the management status of semi-natural grasslands in Saaremaa Municipality. The table also presents the amount of grasslands within and outside of the Saare County GN. The classification of grassland types follows that of LIFE Viva Grass project (Villoslada et al, 2018) and the data has been compiled and aggregated from different sources:

- EELIS (Eesti Looduse Infosüsteem)
- PRIA (Põllumajanduse Registrite ja Informatsiooni Amet)
- PKY (Pärandkoosluste Kaitse Ühing)

Most of the baseline data used refers to the status of grasslands in 2016. However, some of the data regarding semi-natural grassland may refer to fieldworks done in 2001 and later.

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Table 1. Distribution of grasslands by type in Saaremaa Municipality. The extent of grasslands inside and outside of the County GN is shown separately.

Grassland type		Total area (ha)	Total area within GN (ha)	% of GN 166273 ha	Out of GN (ha)
Cultivated		5906	1695	1	4211
Permanent		29743	11426	7	18317
Semi-natural		24833	16195	10	8638
Management regime	Grazing	6341	4299		2042
	Mowing	1494	1370		124
	Grazing & mowing	10	9		1
	Restored	45	43		2
	Abandoned	9686	6737		2949
	No information	7257	3737		3520
TOTAL		60482	29316	18	

The amount of abandoned grasslands is calculated as those grasslands in which agri-environmental payments have not been claimed since 2007. However, these numbers are an approximation and should therefore be taken with care. Approximately 16% of the total area of grassland is likely to be abandoned in Saaremaa. However, grassland abandonment within the Green Network is higher: 42% (6737 ha) of the total area of grasslands are believed to be abandoned.

Around 65% of semi-natural grasslands in Saaremaa are included within the GN. Still the other 35% of semi-natural grasslands is left out of the network.

1.2 Ecosystem services (ES) provided by grasslands

In order to assess the **potential** provision of ecosystem services in Estonian grasslands, Viva Grass project has elaborated a specific grassland classification system based in three main factors comprising both biotic and abiotic components:

- *Land quality (boniteet):* The concept of land quality is an integrated evaluation of fertility of soils used in the Baltic States land evaluation systems and is composed of several factors, e.g. soil texture, soil type, topography and stoniness. Land quality is expressed in points per hectare with 100 points being maximum.
- *Slope:* Steeper slopes are associated with shallower soils with less water retention capacity due to gravity and with a higher risk for soil erosion, thus impacting ES supply potential.
- *The management regime of the grasslands:* Three types of management regime were considered in the analysis. **Cultivated grasslands** are seeded and ploughed, usually included in crop rotation and less than five years of age. **Permanent grasslands** are generally defined as land used to grow grasses naturally or through cultivation which is older than five years. **Semi-natural grasslands** are the result of decades or centuries of low intensity management and are currently not seeded or plughed. **Arable/cropland** is defined as intensively managed farmland used for crop production, plowed at least one time in the season and usually fertilized.

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All factors are combined through GIS algebra, resulting in a total of **30 grassland classes** plus **10 arable land** classes. **Table 2** shows the grassland classes found in Saaremaa Municipality and the ES they provide. The evaluation of ES supply follows an expert-based qualitative scoring methodology which is outlined in Villoslada et al. (2018). The 0 to 5 qualitative scores in table 2 represent an increase in the supply of ES as follows: 0 – No relevant supply of ES   5 – Very high supply of ES

Table 2. Grassland clases in Saaremaa Municipality and the ES they provide

	Provisioning					Regulation & Maintenance							
Grassland classes	Cultivated crops	Reared animals and their outputs	Fodder	Biomass-based energy sources	Herbs for medicine	Bio-remediation by micro-organisms, plants and animals	Filtration/storage/accumulation by ecosystems	Control of (water) erosion rates	Pollination and seed dispersal	Maintaining habitats for plant and animal nursery and reproduction	Weathering processes/soil fertility	Chemical condition of freshwaters	Global climate regulation
1. Cultivated grassland on plain relief, low soil fertility	0	3	2	2	1	2	2	0	2	2	2	2	2
2. Cultivated grassland on plain relief , medium soil fertilty	0	4	3	3	1	3	3	0	2	2	3	3	2
3. Cultivated grassland on plain relief in, high soil fertility	0	5	4	4	1	3	4	0	2	2	4	4	2
4. Cultivated grassland on plain relief, organic soils	0	4	3	3	1	4	4	0	2	2	0	3	3
11. Permanent grassland on plain relief in, low soil fertility	0	2	1	1	3	3	2	0	4	4	2	3	3
12. Permanent grassland on plain relief , medium soil fertilty	0	3	2	2	2	4	3	0	4	3	3	4	3
13. Permanent grassland on plain relief, high soil fertility	0	4	3	3	2	4	4	0	4	3	4	5	3
14. Permanent grassland on plain relief, organic soils	0	3	2	2	2	5	4	0	4	3	0	3	4
21. Semi-natural grassland on plain relief, low soil fertility	0	1	1	1	5	4	2	0	5	5	2	3	4
22. Semi-natural grassland on plain relief, medium soil fertilty	0	2	2	2	4	5	3	0	5	4	3	4	4
23. Semi-natural grassland on plain relief, high soil fertility	0	3	3	3	3	5	4	0	5	3	4	5	4
24. Semi-natural grassland on plain relief, organic soils	0	3	3	3	4	5	4	0	5	4	0	3	5

Table 2 shows a clear difference between the ES provided by cultivated grasslands and those provided by permanent and semi-natural grasslands. Permanent and semi-natural grasslands have a key role in the provision of regulation and maintenance ES whereas cultivated grasslands show a high potential for provisioning ES.

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1.2.1 Assessment of ES supply applying the Viva Grass Tool: Viewer

The Viva Grass online tool allows assessing the provision of ES by grasslands in a spatially explicit way. By accessing the Viva Grass tool ***Viewer*** it is possible to spatially locate grassland classes and the ES they provide, as well as visualize the potential supply of ES through bar graphs. **Figure 1** shows an example of a grassland classes map generated by the Viva Grass Tool and one ES provided by grasslands. In order to view the full set of ES provided by grasslands in Saaremaa Municipality, access the Viva Grass Tool *Viewer* (https://vgrass.hnit-baltic.lt/vgsites/vgviewer/). It is recommended to use the ***Viewer*** section of the Viva Grass Integrated Planning Tool as an initial step to understand the general patterns of grassland types and distribution as well as potential supply of ES. Moreover, the ***Viewer*** provides information on ES synergies and trade-offs. More detailed information about this topic is provided on the next section.

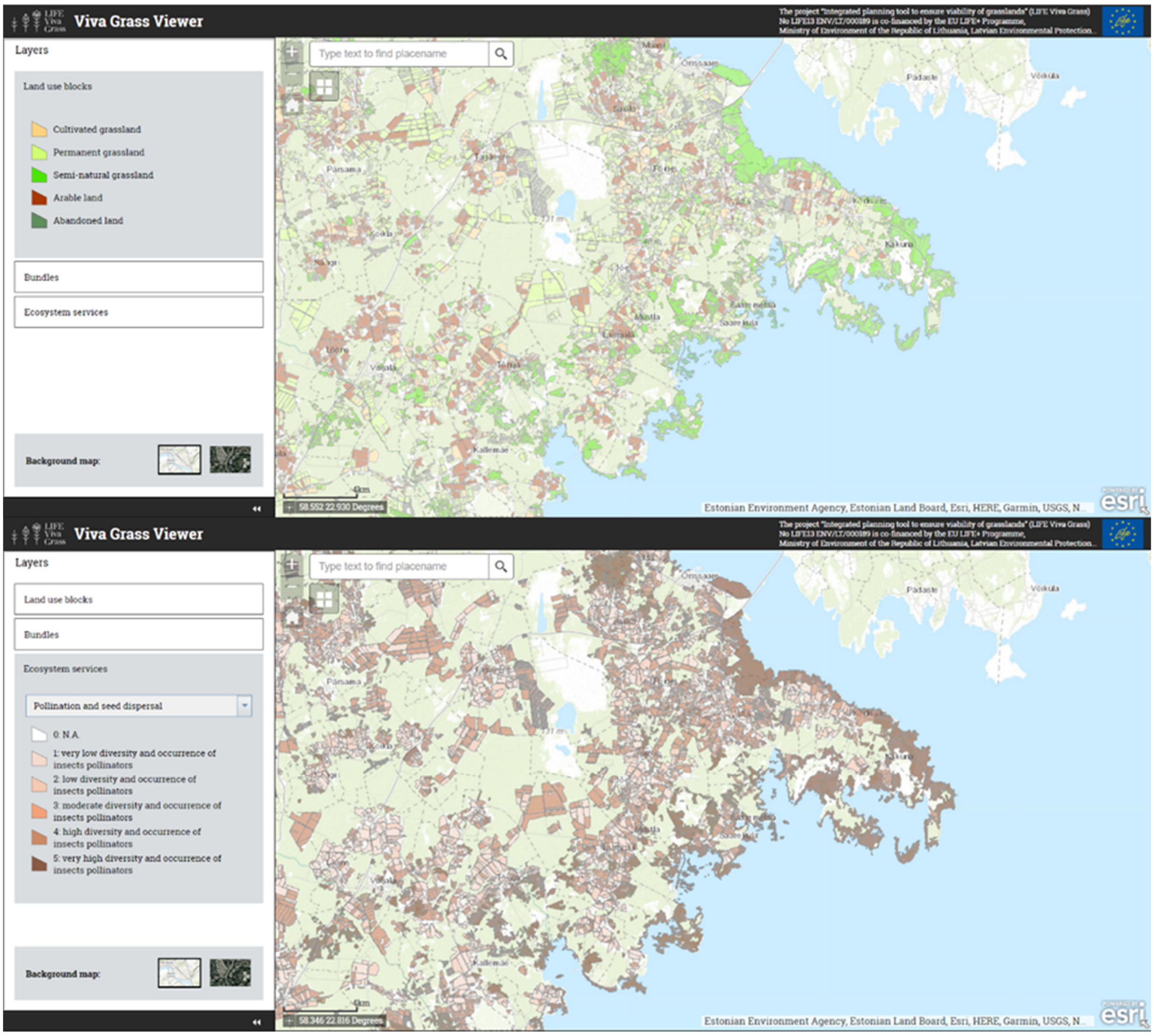

Figure 1. Viva Grass viewer displaying grassland classes (upper image) and one ES: *pollination and seed dispersal* (lower image).

1.2.2 ES bundles, synergies and tradeoffs

Not all ecosystem services occur together in the same location and time. On the other hand, certain ecosystem services repeatedly appear together in time and/or space. These groups of ES are known as bundles. The ES that form a bundle can interact together, leading to **synergies** and **trade-offs**, when the

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interaction is positive or negative respectively. We talk about **synergies** when the use of one ES would increase the benefits supplied by another service or group of services. The implications of this type of interaction are of high importance for planning and management strategies. For example, maintaining a high number of perennial grassland species in semi-natural grasslands both supports habitats but also attracts a high number of pollinators: bees, butterflies and bumblebees. By enhancing the population of pollinators, we also increase the pollination rate in nearby cultivars, highlighting the fact that the synergies can happen also at different locations. The term **trade-offs** refers to an interaction in which some ecosystem services are provided at the expense of others. This means that an increase in the production of a service would decrease the production and benefits of other service. A clear example in the context of grasslands is the tradeoff between biomass production and biodiversity and habitats: Increasing grasslands productivity usually requires a certain degree of intensification through fertilization, ploughing and reseeding with a mix of selected species. These intensification practices in turn simplify grasslands' structure and decrease the number of grassland species, leading to a loss of habitats for birds and arthropods.

Within Viva Grass project, three bundles have been identified in the study areas, namely:

Production synergy: This synergy is formed by five ecosystem services closely related to the productivity of ecosystems: *Reared animals and their outputs, fodder, biomass-based energy sources, weathering processes/soil fertility* and *cultivated crops*. In this particular synergy, the underlying ecosystem function that drives the production of the three ES is the net primary production, or biomass production. Therefore, the increase in one of the services in this bundle usually means an increase in the other two services. However, biomass for energy not only depends on the productivity of grasslands, but also on the calorific potential of grassland species.

Habitats synergy: Four ecosystem services interact in this bundle: *Herbs for medicine, maintaining habitats, global climate regulation* and *pollination and seed dispersal*. The increase in one of the services in this bundle usually means an increase in the other two services. For example, in species rich grasslands, we are also likely to find a wide range of herbs with a medicinal value. Moreover, grassland management practices that aim to increase biodiversity, such us the reduction or complete elimination of plowing, and fertilization, also increase the carbon sequestration capacity of soils, which is a key service for the regulation of climate.

Soil synergy: The four ecosystem services that form this bundle are related with the role of soil functions in ecosystem processes: *Bio-remediation, filtration/storage/accumulation* and *chemical condition of fresh waters and control of erosion rates*. The increase in one of the services in this bundle usually means an increase in the other two services.

A fourth interaction between ES was identified as a **trade-off** between production and habitat bundles: As explained before, management strategies that aim at increasing the productivity of ecosystems also lead to a decrease in the number of grassland species and consequently a decrease in pollination services.

Figure 2 shows the habitats synergy map in Saaremaa grasslands as displayed in the Viva Grass Integrated Planning Tool Viewer.

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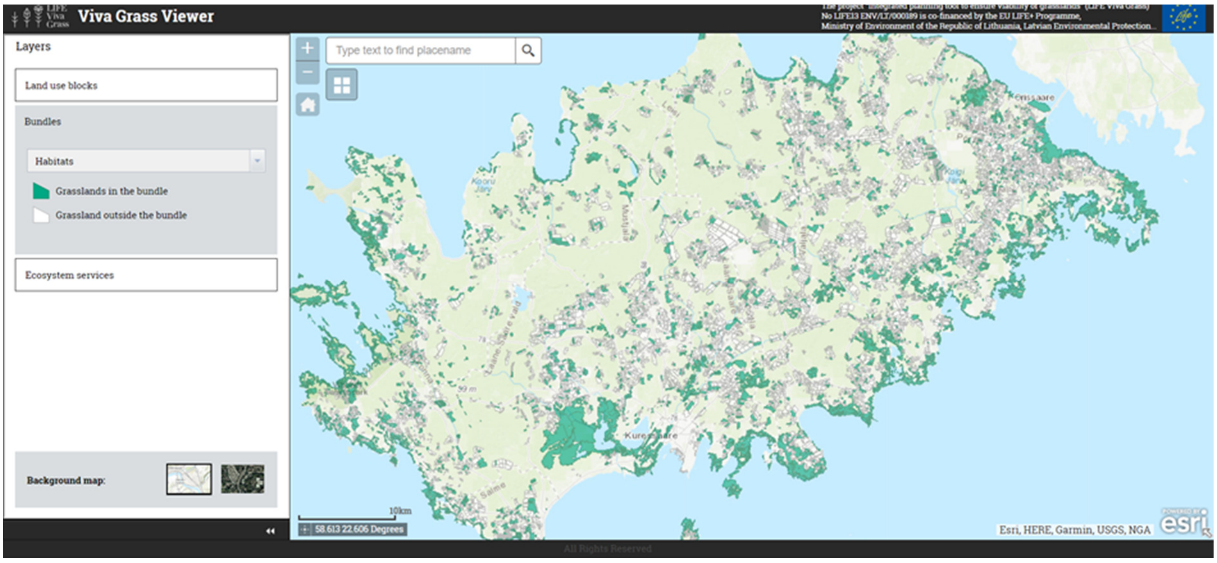

Figure 2. Habitats bundle in Saaremaa Municipality visualized in the Viva Grass Tool.

1.2.3 Hotspots and coldspots of ecosystem services

Within Viva Grass, ecosystem services hotspots are understood as areas where a great number of services are provided at high or very high values. On the other hand, ecosystem services coldspots are understood as areas where a great number of services are provided at low or very low values. The user can explore 3 different layers under the hot/coldspots tab (see Fig. 3). The default layer hotspots-coldspots is the combination of number of ES with high values and number of ES with low values. The hot-cold spots analysis in Viva Grass gives an overview of the potential multifunctionality of the territory in terms of ES supply. As a general rule, hotspots are vulnerable to agricultural intensification due to their good agro-ecological conditions. It is recommended to use the hot-coldspots analysis as a tool to identify highly valuable areas with specific agro-environmental conditions. As an example, the grassland belt around Kanissaare and Kübassaare in Eastern Saaremaa (Fig. 3) shows high/very high values of multiple ES, indicating key areas of grasslands multifunctionality.

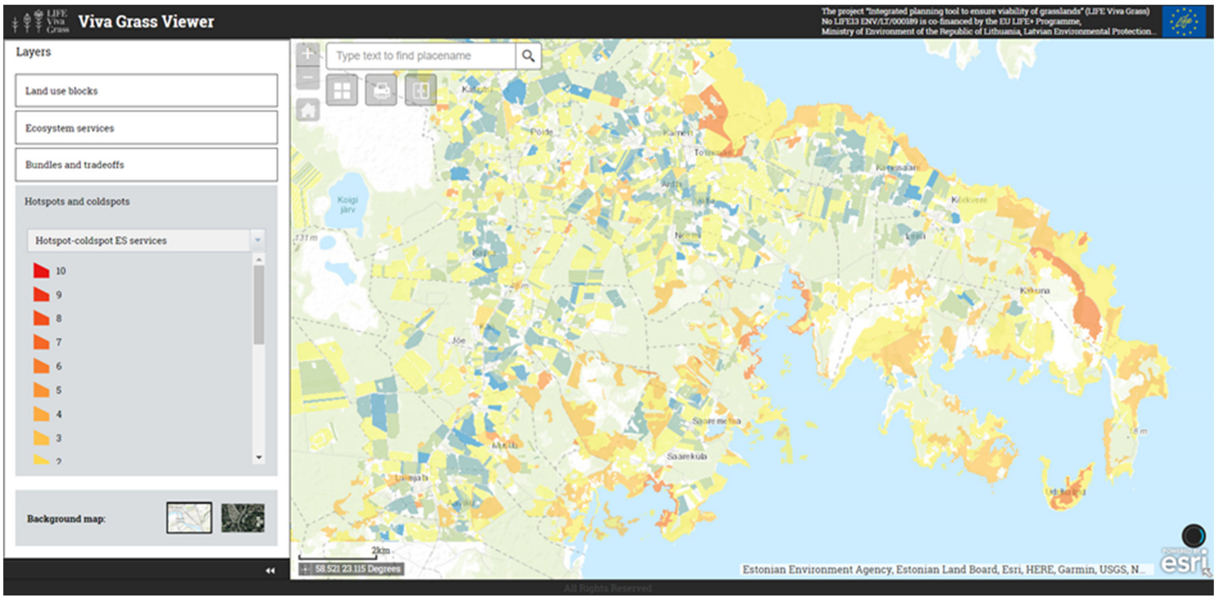

Figure 3. Ecosystem services hot and cold spots in Matsalu Bay and surrounding areas.

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1.2.4 Landuse change assessment

Tool users have the possibility to explore the estimated effects of landuse change on the potential supply of ES. By clicking on a land block of interest, the user can view ES provided by the selected grassland. The tool offers the possibility to select an alternative landuse (arable, cultivated, permanent, seminatural) from a drop down menu. The expected relative change of ES supply potential is shown next to each ES (Fig. 4). The change in ES supply is shown as a relative increase, decrease or no relative impact. This tool is helpful to explore the impacts of landuse change on ES supply. Specifically, changes in agricultural management practices affect the capacity of ecosystems to deliver services. For instance, higher intensity management factors aimed at increasing forage production such as increased use of organic and mineral fertilizers, ploughing, reseeding and drainage may, in turn, lead to an impoverishment of vascular plant species and soil biota diversity. As a consequence, significant decreases in the supply of key ecosystem services are triggered: lower pollination services associated to lower plant species diversity and lower capacity of soils to fix carbon and lower nutrient cycling capacity due to soil structure degradation and reduced soil biota).

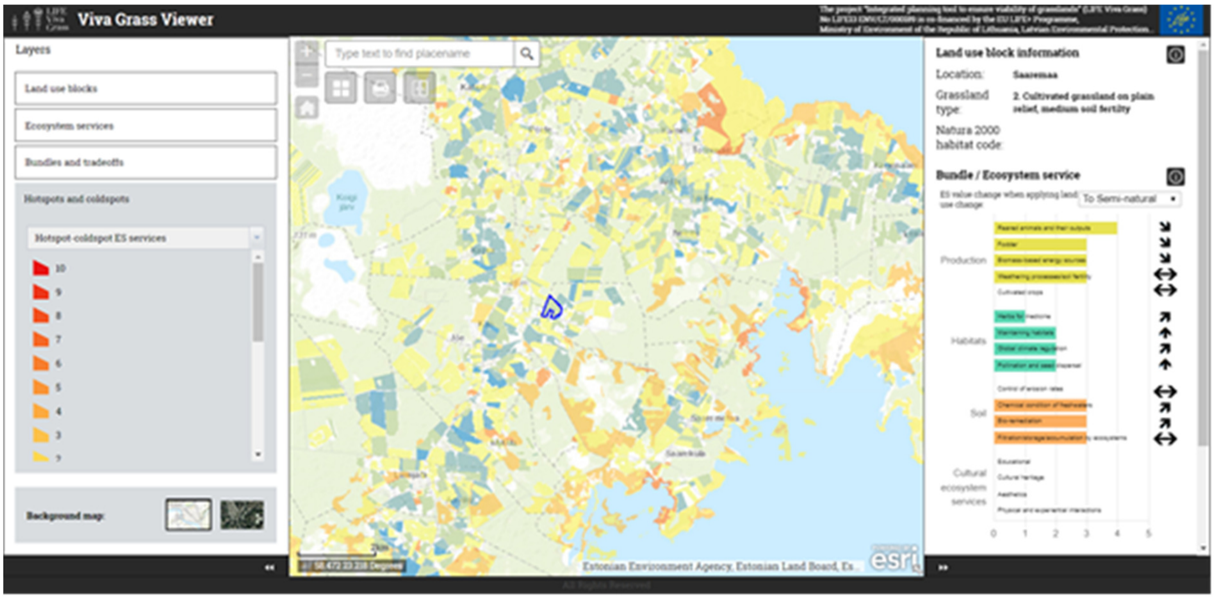

Figure 4. Landuse change assessment in the Viva Grass viewer.

2. GREEN NETWORK

2.1 Conservation status of semi-natural grasslands within the Saare County Green Network

Semi-natural grasslands are a key element of the Green Network of Estonia and their preservation and conservation contribute to the objectives of the green network, as stated in the National Spatial Plan "Estonia 2030+" (Estonian Ministry of the Interior, 2012). The conservation status of semi-natural grasslands determines their value within the GN and helps identify degraded grasslands that require restoration measures. Moreover, degraded and abandoned grasslands considerably lose their capacity to provide key ES such as *pollination and seed dispersal* or *maintaining habitats*, therefore impoverishing the overall functionality of the green network.

Table 3 contains the extent and conservation status of all semi-natural grassland habitats in Saare County. The classification of semi-natural grassland is based on the Habitats Directive Annex I codes. The conservation status codes are translated as follows:

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A: Very high conservation value; B: High conservation value; C: Average conservation value; D: Low conservation value

Table 3. Extent and conservation status of semi-natural grasslands **inside** Saare County Green Network.

Habitat type	Conservation status										
	A (ha)	%	B (ha)	%	C (ha)	%	D (ha)	%	unknown (ha)	%	TOTAL (ha)
1630*	1105	*31*	1063	*29*	894	*25*	1	*0*	549	15	3698
4030	-	*0*	13	*99*	0	*1*	-	*0*		0	113
5130	92	*12*	347	*45*	260	*34*	30	*4*	45	6	868
6210*	258	*28*	229	*25*	346	*38*	7	*1*	67	7	999
6270*	32	*13*	106	*44*	76	*32*	-	*0*	28	12	330
6280*	1058	*28*	1185	*32*	1185	*32*	4	*0*	315	8	3839
6410	66	*9*	131	*17*	533	*69*	6	*1*	36	5	868
6430	12	*8*	52	*38*	62	*45*	0	*0*	12	9	229
6450	24	*63*	6	*15*	1	*3*	-	*0*	8	20	119
6510	1	*0*	53	*30*	109	*62*	6	*4*	7	4	272
6530*	203	*17*	486	*40*	211	*18*	23	*2*	278	23	1278
7230	364	*12*	543	*19*	1931	*66*	1	*0*	91	3	3028
9070	439	*31*	506	*36*	338	*24*	15	*1*	119	8	1509

Molinia meadows on calcareous, peaty or clayey-silt laden soils (6410), *Alkaline fens* (7230) and *Lowland hay meadows* (6510) show the worst conservation status, with over 50% of their extension within the green network classified as average conservation status (C).

Table 4. Area and conservation status of semi-natural grasslands **outside** the Saare County Green Network

Habitat type	Conservation staus										
	A (ha)	%	B (ha)	%	C (ha)	%	D (ha)	%	unknown	%	TOTAL (ha)
1630*	577	*26*	910	*40*	504	*22*	0	*0*	263	*12*	2254
4030	0	*0*	1	*100*	0	*0*	0	*0*	0	*0*	1
5130	15	*2*	394	*57*	205	*30*	0	*0*	76	*11*	690
6210*	263	*28*	193	*21*	274	*29*	6	*1*	193	*21*	930
6270*	29	*26*	31	*28*	43	*38*	0	*0*	9	*8*	112
6280*	485	*16*	628	*21*	1692	*57*	2	*0*	137	*5*	2944
6410	22	*16*	78	*57*	24	*18*	2	*1*	11	*8*	137
6430	3	*8*	9	*24*	16	*42*	2	*5*	7	*18*	38
6450	5	*11*	15	*33*	23	*51*	0	*0*	2	*4*	45
6510	9	*6*	17	*12*	102	*70*	13	*9*	6	*4*	146
6530*	99	*18*	205	*37*	124	*23*	7	*1*	115	*21*	550
7230	47	*16*	78	*26*	171	*57*	0	*0*	3	*1*	300
9070	219	*31*	326	*45*	113	*16*	0	*0*	58	*8*	717

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Tables 3 and 4 reflect the considerable area of semi-natural grassland habitats left out by the Saare County Green Network. This is especially noteworthy in the case of *Boreal Baltic coastal meadows (1630*), Semi-natural dry grasslands and scrubland facies on calcareous substrates (6210*)* and *Nordic alvar and precambrian calcareous flatrocks (6280*).* Moreover, a substantial area of these grassland habitats show a bad conservation status (C or D), especially in the case of alvars. These figures support the need for a better design of the green network at the level of the municipality, which would ensure the potential delivery of ES provided by grasslands.

The following sections show how to use the information and datasets produced in Viva Grass in order to include valuable grasslands in the design process of the green network in Saaremaa Municipality.

2.2 Prioritization DMS for Green Network: Oucomes and recommendations for application

The prioritization Decision Management System (DMS) developed within the framework of the Viva Grass integrated planning tool allows planners and a wider range of stakeholders to query information related to the role of grasslands within the Green Network of Estonia. The main objectives of the Green Network DMS are:

1. Guiding planners into the adoption of the County-level GN in rural municipality General Plan
2. Stressing the role of grasslands in the GN (delivery of ES, conservation status)
3. Detecting possible landuse conflicts in the GN implementation

In Saare Municipality case study, the Green Network DMS provides a number of options or scenarios to implement Saare County Green Network in Saare Municipality general plan. The present report showcases the outputs of the Green Network DMS in Saare Municipality and outlines a number of steps and recommendations on the use of the DMS and the implementation of the results.

2.2.1 Application of the prioritization DMS in Saaremaa Municipality Green Network: Concept and theoretical framework

There is a need to keep healthy ecosystems inside the green network in order to ensure multifunctionality and the delivery of ES. In this regard, Viva Grass **prioritization DMS for Green Network** allows to simultaneously visualize potential ES delivered by grasslands and their conservation status.

In order to guide planners in the adoption of the County-level GN into the rural municipality General Plans, the **prioritization DMS for Green Network** proposes set of three predefined scenarios. The scenarios are understood as a gradually increasing (or decreasing) degree of inclusion and protection of grasslands in the GN. Scenario 3 represents the highest possible degree of ES supply, as all valuable grasslands belonging to the *habitats synergy* and the *soils synergy* plus grasslands containing protected species are incorporated in the Green Network. By including grasslands belonging to ES bundles in the green network, we ensure the protection of *regulating and maintenance* ecosystem services, which are essential to preserve the overall coherence and functioning of the Green Network.

The criteria for the inclusion of semi-natural grasslands in the GN of rural municipality General Plan is based on their capacity to potentially deliver a certain set of ES. This capacity reaches a high level of

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multifunctionality when a certain grassland is part of an ecosystem services synergy (see section 1.2.2). In grasslands belonging to an ES synergy, the increase of the supply in one ES means an increase in the supply of more ES. In terms of the role of semi-natural grasslands inside the green network, the *habitats synergy* and the *soils synergy* offer a wide array of environmental benefits. These benefits (soil protection, pollination, etc.) are not only constrained to the grassland plot itself, but have a wider spatial effect (e.g. increased pollination benefits also surrounding agricultural land).

The GN scenarios and the criteria used for the inclusion of grasslands in the scenarios are outlined below. **Figure 5** shows the different sets of ecosystem services enhanced under each GN scenario.

Scenario 1. Bare minimum: only grasslands in the **habitats bundle** are included in scenario 1.

Scenario 2. Medium ecological coherence: grasslands in the **habitats bundle** and grasslands that contain protected species are included in scenario 2.

Scenario 3. High ecological coherence: grasslands in the **habitats bundle**, grasslands in the **soils bundle** and grasslands that contain protected species are included in scenario 3. This represents the ideal scenario in terms of multiple ES delivery.

	Scenario 1	Scenario 2	Scenario 3
Pollination and seed dispersal	High increase	High increase	High increase
Maintaining habitats	Medium increase	High increase	High increase
Global climate regulation	High increase	High increase	High increase
Herbs for medicine	High increase	High increase	High increase
Control of erosion rates	Low increase	Low increase	High increase
Chemical condition of fresh waters	Low increase	Low increase	High increase
Bio-remediation	Low increase	Low increase	High increase
Filtration-storage accumulation	Low increase	Low increase	High increase
Soil fertility	Low increase	Low increase	Low increase
Fodder	No increase or decrease	No increase or decrease	Low increase
Biomass-based energy sources	No increase or decrease	No increase or decrease	Low increase
Reared animals and their outputs	No increase or decrease	No increase or decrease	Low increase
Cultivated crops	No increase or decrease	No increase or decrease	Low increase

Figure 5. Relative of ES in different GN scenarios, where:

- ↑ (dark) High increase
- ↑ (medium) Medium increase
- ↑ (light) Low increase
- ↔ No increase or decrease

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2.2.2 Application of the prioritization DMS in the Saaremaa Municipality Green Network: Outputs and interpretation of results

As outlined in the previous section, the Green Network (GN) DMS produces three scenarios with a gradually increasing degree of inclusion and protection of grasslands in the GN. The user can generate and visualize GN scenarios in two different ways:

(1) Accessing the base data in shapefile format

(2) Through the prioritization DMS in the Viva Grass tool

2.2.2.1 Base data in shapefile format

Figure 6 shows the structure of the attribute table of the green network shapefile. Three consecutive columns contain the information about grasslands included in scenarios 1, 2 and 3: *gn_sc1* (bare minimum), *gn_sc2* (medium ecological coherence), *gn_sc3* (high ecological coherence). Grasslands marked with a “1” belong to the green network scenario.

	n2000	tradeoff	landuse	gn_sc1	gn_sc2	gn_sc3
0		1	p	0	1	1
1		0	p	0	0	1
1		0	p	0	0	1
1		0	p	0	0	1
0		1	p	0	1	1
1		0	p	0	0	1
1		0	p	0	1	1
1		0	p	0	0	1
1		0	p	0	1	1
1		0	p	0	0	1
1		0	p	0	1	1
0		1	p	0	1	1
1		0	p	0	0	1
1		0	p	0	0	1
0		1	p	0	1	1
0		1	p	0	1	1

Figure 6. Close up of green network shapefile attribute table. The last three columns (*gn_sc1, gn_sc2* and *gn_sc3*) indicate the green network scenario to which a particular grassland belongs.

In order to understand the location of valuable grasslands as potential elements of the green network, it is necessary to visualize the three scenarios in a spatially explicit manner through maps (Fig. 7). Maps are complemented with information on the extent of grasslands included in each scenario and the degree of delivery of each ecosystem service (from 0 to 5) (Fig. 8).

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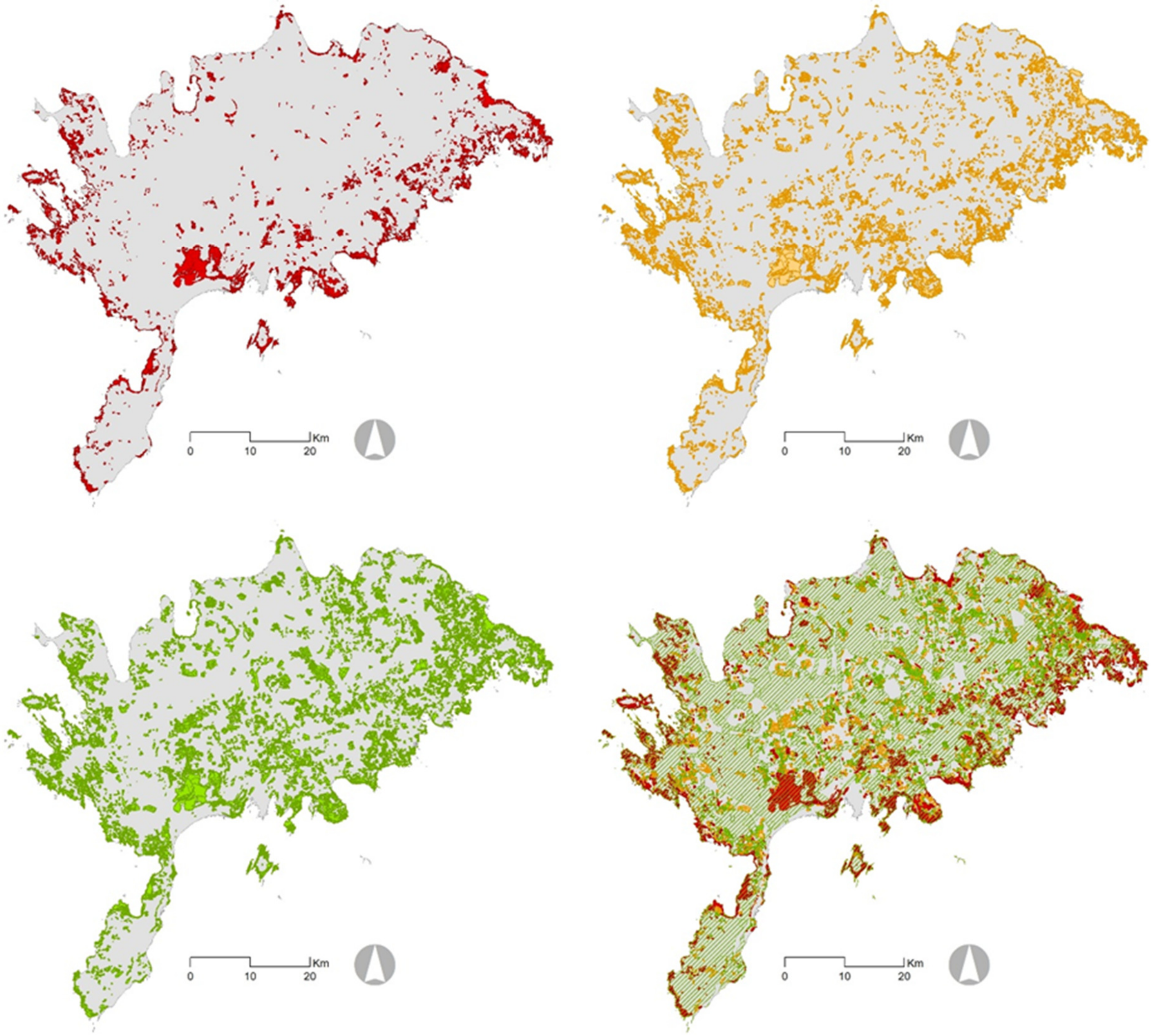

Figure 7. Three consecutive scenarios of grassland inclusion in Saaremaa GN: (a) Scenario 1: bare minimum, (b) Scenario 2: medium ecological coherence, (c) Scenario 3: High ecological coherence. The overlap of the three scenarios with Saare County GN is shown in image (d).

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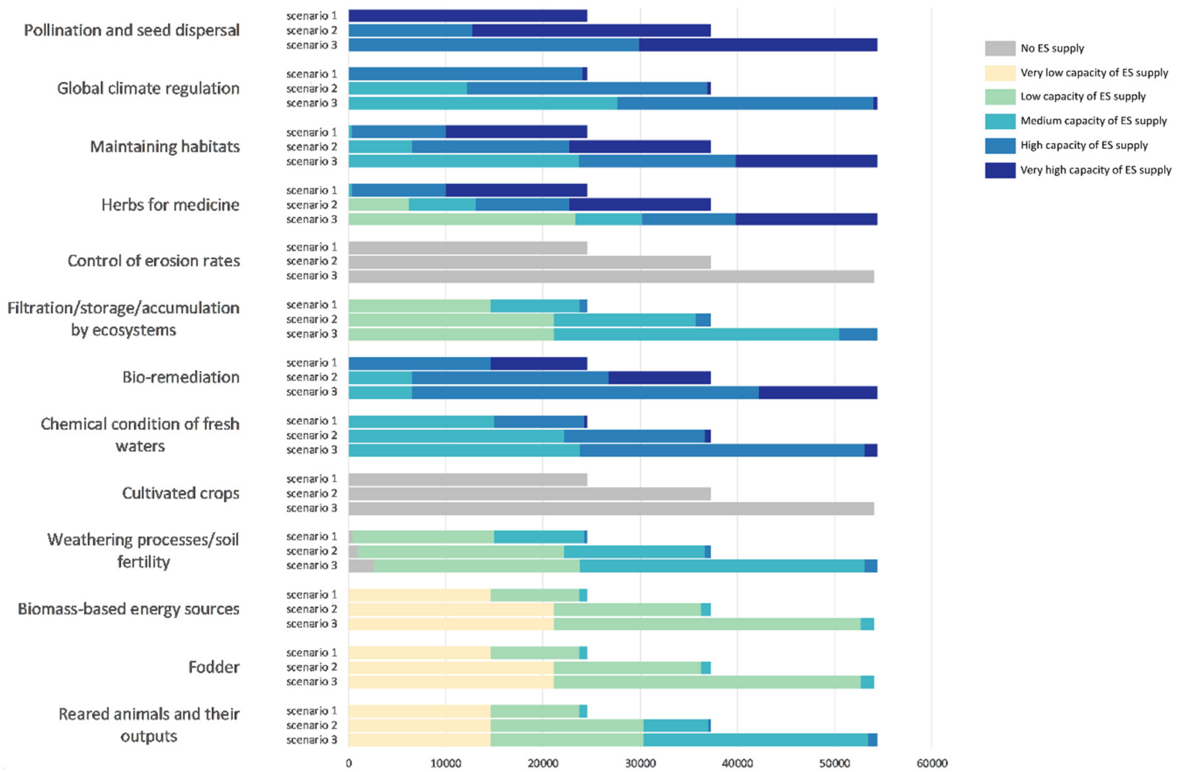

Figure 8. The supply of each ES under each GN scenario in Saare municipality. The Y axis displays the number of ha of grassland included under each scenario.

Figures 7 and **8** show how each GN scenario entails an increase in the area of grasslands included (24540, 37276 and 54009 ha respectively in scenarios 1, 2 and 3). This increase in the area of grasslands in the GN also encompass an increase in the supply of ES. For instance, in scenario 1, 24540 ha have a *very high capacity of delivery of* ***pollination and seed dispersal***. In scenario 2, additionally 12736 ha of grassland have a *high capacity of delivery of* ***pollination and seed dispersal***. In scenario 3 (high ecological coherence) the highest possible supply of ES is achieved with 24540 ha having a *very high capacity of delivery of* ***pollination and seed dispersal*** and 29833 ha having a *high capacity of delivery of* ***pollination and seed dispersal.***

The selection criteria for including grasslands in the GN highlight those ES related to the habitats synergy (see section 1.2.2). This can be clearly observed in **Figure 8:** Habitats and soil-related ES score the highest whereas production-related ES score the lowest, due to the inclusion of mainly semi-natural and permanent grasslands in the GN. As outlined in the previous section, including grasslands belonging to the habitats and soils synergies ensures the protection of regulating and maintenance ecosystem services.

Both the maps and the areas shown in **Figures 7** and **8** should work as guiding information for the planner, in order to gain a deeper understanding of which ES are provide by grasslands included in the GN and the extent to which these ES are provided.

2.2.2.2 Prioritization DMS in the Viva Grass tool

The prioritization DMS allows to visualize a pre-built set of 3 GN scenarios (see previous sections). The displayed of scenarios is achieved through selections based on attributes. In order to visualize the GN scenarios in the prioritization DMS, the following steps are needed:

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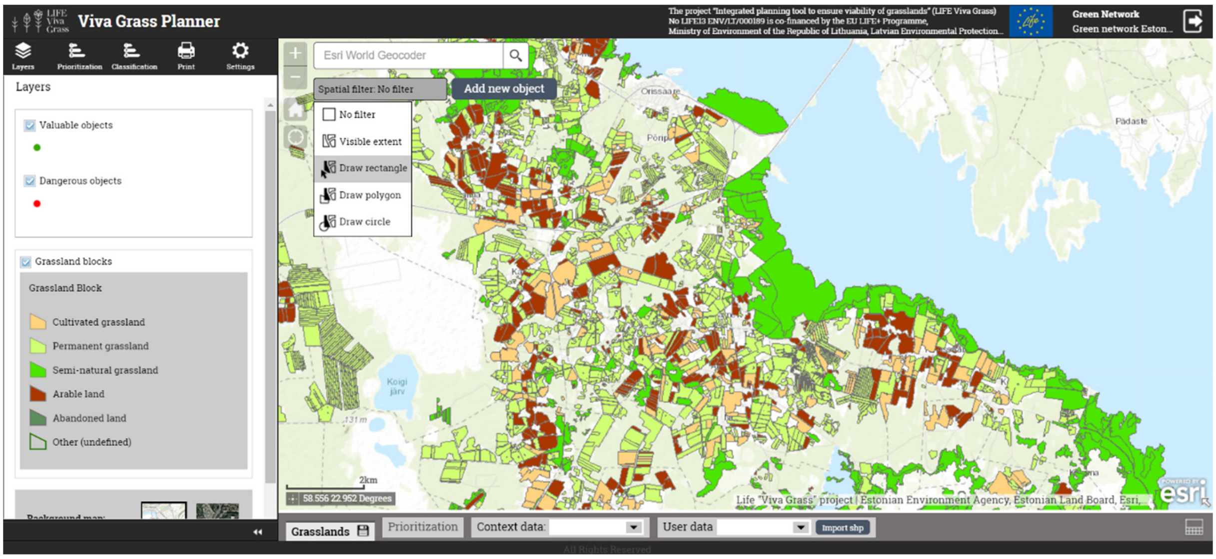
1. Access the Prioritization DMS through https://vgrass.hnit-baltic.lt/vgsites/priority/
2. Zoom into the area of interest and draw a rectangle to select the area where the GN scenarios will be displayed



3. Access the *classification* menu, *new classification* and click *add* to create a new selection.

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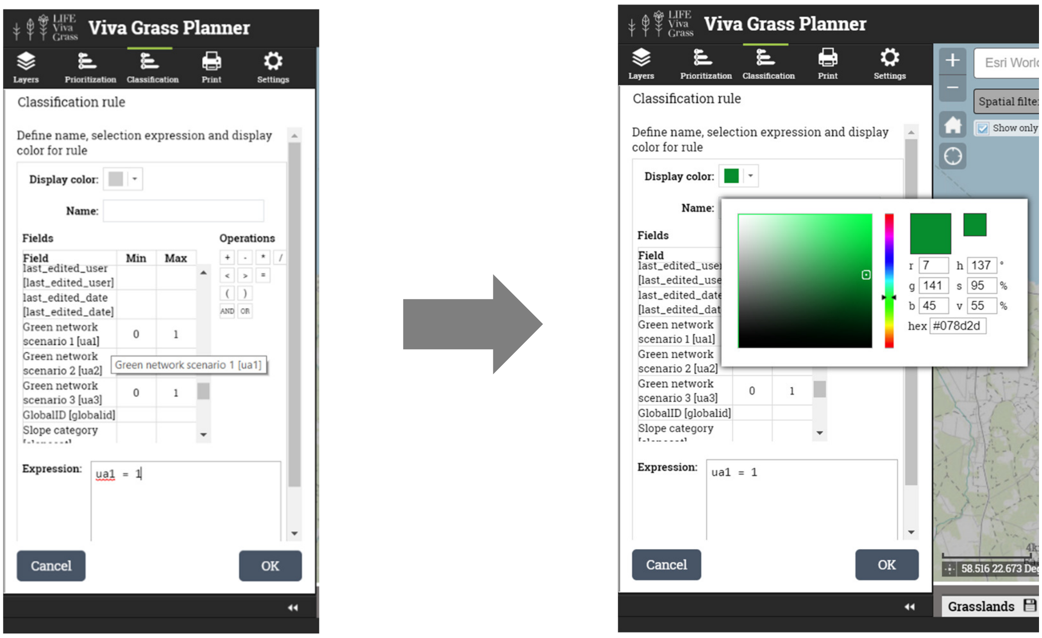
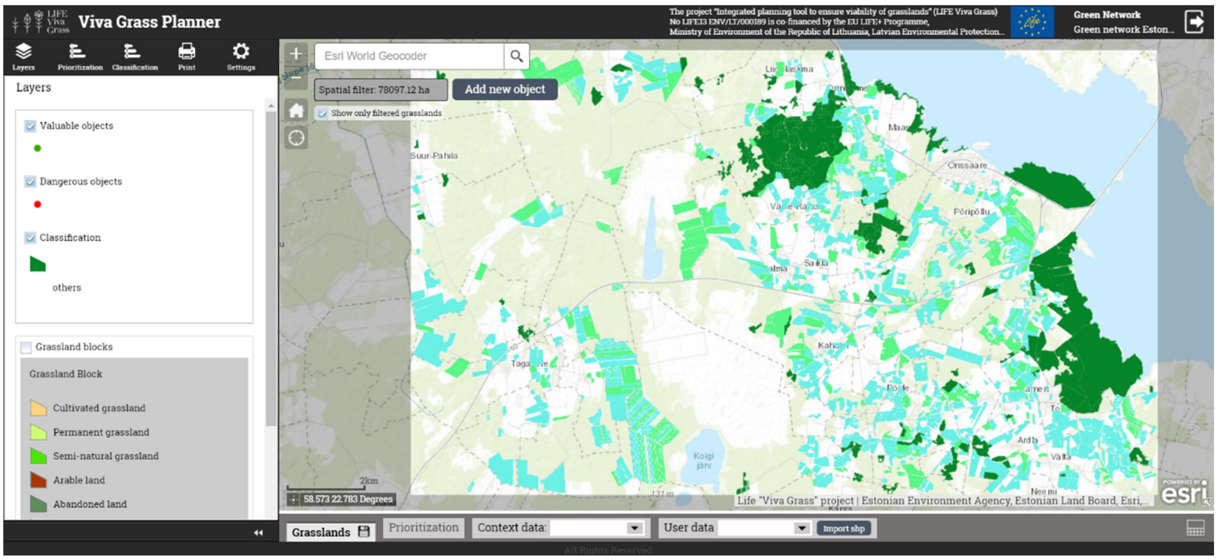
4. Each GN scenario needs a new classification. In order to visualize 3 scenarios simultaneously, 3 classification expressions need to be built. In order to build a classification, select the attribute of interest, in this case *Green network scenario 1* and build a logical expression based on the attribute's values. In this case a value of 1 means a grassland polygon belongs to the 1st GN scenario.



5. Proceed in the same manner to construct scenarios 2 and 3.
6. The selection can be visualized in the *layers* panel.



7. Additionally, other layers can be visualized on top of the GN scenarios. It may be useful to compare the extent of the county level GN with the scenarios proposed by the tool. In order to do so, pack the shapefile layer of your choice into a .zip and in Web Mercator projection. Upload the packed

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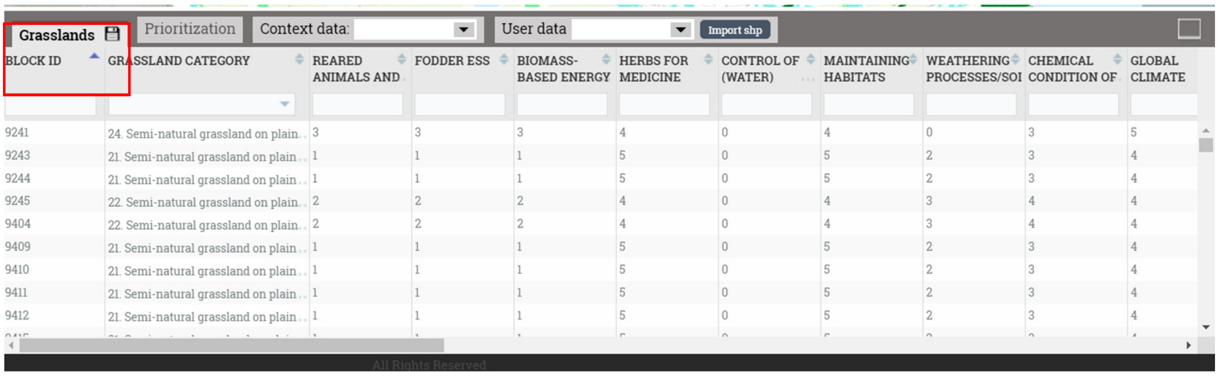
shapefile through the *Import shp* tab. The layer will be automatically loaded in the layers menu and visualized.

8. The selected grasslands can also be downloaded through the *save* menu. This would allow the user to develop more complex GIS operations with the downloaded .shp layers.



BLOCK ID	GRASSLAND CATEGORY	REARED ANIMALS AND	FODDER ESS	BIOMASS-BASED ENERGY	HERBS FOR MEDICINE	CONTROL OF (WATER)	MAINTAINING HABITATS	WEATHERING PROCESSES/SOI	CHEMICAL CONDITION OF	GLOBAL CLIMATE
9241	24. Semi-natural grassland on plain...	3	3	3	4	0	4	0	3	5
9243	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4
9244	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4
9245	22. Semi-natural grassland on plain...	2	2	2	4	0	4	3	4	4
9404	22. Semi-natural grassland on plain...	2	2	2	4	0	4	3	4	4
9409	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4
9410	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4
9411	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4
9412	21. Semi-natural grassland on plain...	1	1	1	5	0	5	2	3	4

2.2.2.3 Green Network scenarios: suggestions for use

In this example, we illustrate possibilities and suggestions for use of the GN scenarios data in a stepwise manner.

1. **Scoping the data**

You can use the Viva Grass Prioritization tool to have an overview of the grasslands included in the GN scenarios and the way they overlap the county GN at any given location. In this step you can examine locations where a large extent of valuable grasslands are not being accounted in the County GN. Beyond the pre-set scenarios, you can generate any queries or combination of queries based on different ES and their values, using the *Classification* tool (see previous section). Moreover, you can upload any dataset in .shp format (i.e. GN, general plan, comprehensive plan, etc.) and assess the way it intersects the proposed scenarios.

After exploring the data, you can download the scenario(s) or selected grasslands of your choice.

2. **Defining GN objectives**

After the previous step, it is highly recommended to overlay the grasslands layers with other relevant layers of information (e.g. forests, agricultural land, protected areas, cultural heritage objects, etc.) in order to gain a full understanding of the spatial disposition of the territory under analysis. Based on available data, local knowledge and the general objectives of the county GN, the specific objectives of the Municipality GN must be defined.

For instance, the planning objectives for a municipality GN could be (1) ensuring biodiversity, interconnecting the main natural values, and (2) ensuring the coherence of natural ecosystems by linking nature conservation areas and biodiversity focal points. The dataset obtained in the previous step can be used to assess the potentialities of the territory to fulfill GN objectives.

Conflicting goals may emerge as a result of this step.

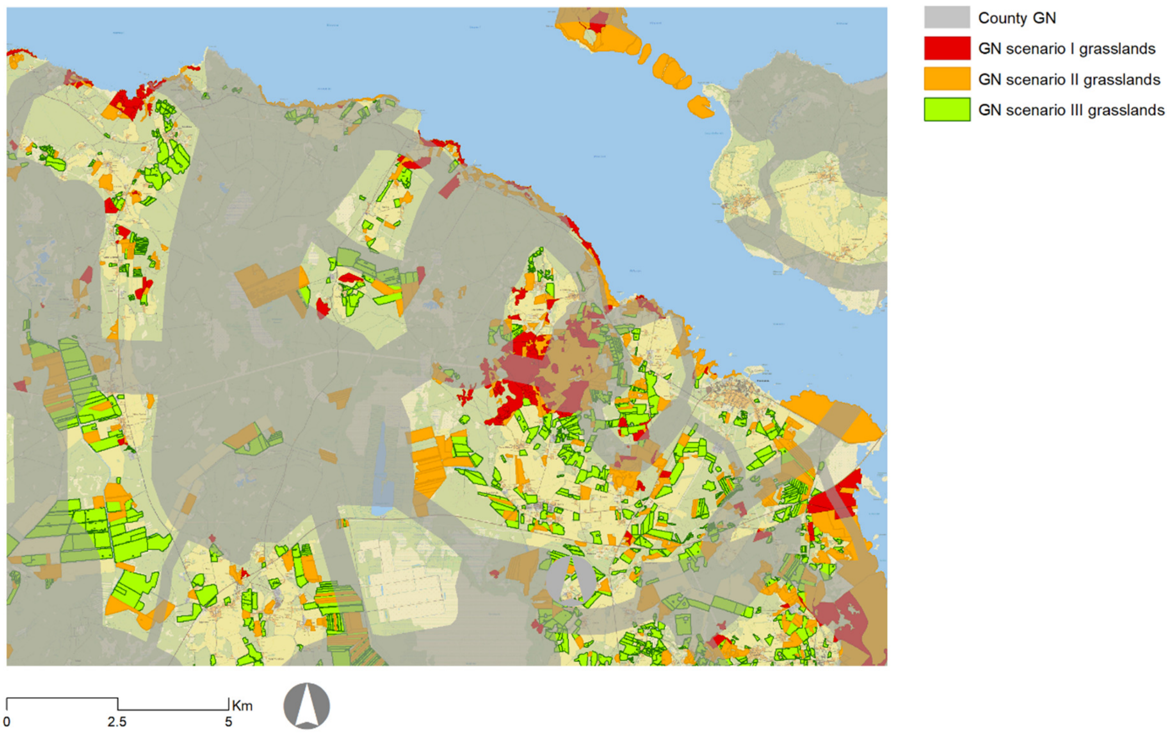


Figure 9. An example of layers overlay in Northeast Saaremaa. The county GN is overlayed on top of the three GN scenarios.

3. Enhancing the municipality GN and analysis of performance

In order to understand the need for GN enhancing, it is necessary to assess the GN current boundaries in relation to the territory from the perspective of multiple ecosystems services supply and multifunctionality. The GN should be analyzed as:

a) A tool for biodiversity conservation
b) A tool for keeping ecological coherence
c) A provider of recreational services

→ The Viva Grass GN grasslands shapefile layer provides relevant information in relation to the abovementioned key points: Number of protected species per grassland plot, ecosystem services supply and recreation-related ecosystem services supply.

3.a Preservation of biodiversity

One the GN main functions is the preservation of biodiversity. In this regard, it is necessary to identify:

a) Highly biodiverse areas
b) Fragmented habitats

→ The Viva Grass GN grasslands shapefile layer provides useful information in terms of identifying fragmented patches of valuable grasslands and highly biodiverse grasslands.

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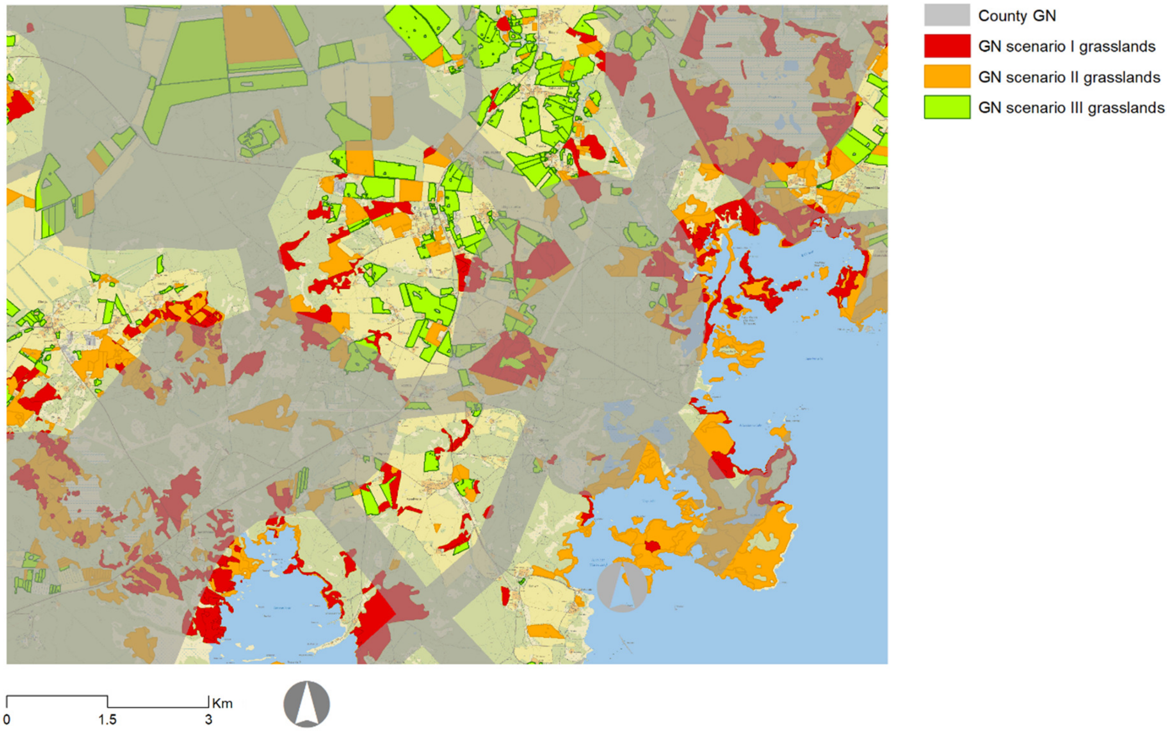

Figure 10. Valuable grasslands belonging to the GN scenario I show patterns of fragmentation.

3.b Ecological coherence and landscape multifunctionality

In order to achieve a GN that provides both high levels of multifunctionality and ecological coherence, it is necessary to:

a) Identify areas that provide high levels of multiple ecosystem services, with a focus on *regulating and maintenance* ecosystem services.
b) Ensure that core areas are sufficiently connected.

→ The Viva Grass GN grasslands shapefile layer contains useful information in terms of identifying grasslands providing high levels of multiple ecosystem services.

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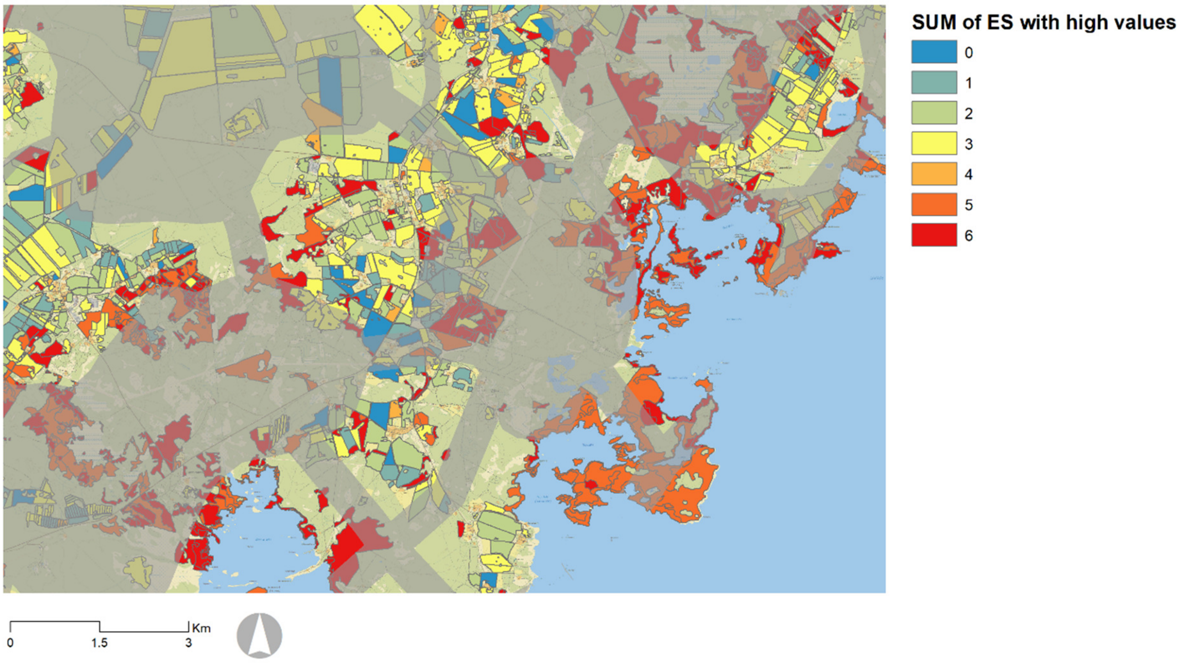

Figure 11. ES hotspots map in East Saaremaa. Grassland multifunctionality is represented as the number of ES with high values (>3).

3.c Recreational services

The GN acts as a provider of recreation, especially in the vicinity of urban areas and settlements. It is therefore necessary to identify potential recreational values of the GN components.

→ The Viva Grass GN grasslands shapefile layer provides information on grasslands recreation and education ecosystem services.

4. Identify conflicts and design GN

Although the GN is inherently multifunctional, it is necessary to identify conflicts of interest in the design phase. Once potential conflicts and overlaps are identified, the information gathered in previous steps will be used to design and implement the municipality GN.

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