Recommendations on applying the Viva Grass Tool to the farm's management

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Introduction

The LIFE Viva Grass project aims to support maintenance of biodiversity and ecosystem services provided by grasslands, through encouraging ecosystem-based planning and economically viable grassland management. The project also wanted to demonstrate options for multifunctional use of grasslands' ecosystem services as a basis for sustainable development of the remote rural areas in the Baltics which suffer greatly from abandonment of semi-natural grasslands and in recent years also from the intensification of agriculture.

The main outcome of the project is the "Viva Grass Integrated Planning Tool"[1] (further – "Viva Grass tool") for increasing the effectiveness of grassland management. It is an IT tool supporting decision making in planning of sustainable use and management of grasslands for the future. It enables integration of grassland ecosystem services into planning and decision making by linking biophysical data (e.g. land quality, relief, land use, habitat types) with estimates of the ecosystem services and socio-economic context. The Viva Grass tool is integrated into an online GIS-based (Geographic Information System) environment and allows users to assess the supply and trade-offs of grassland ecosystem services in user-defined areas, as well as to develop ecosystem-based grassland management and planning scenarios. The Viva Grass tool also serves an informative and educational purpose, showing the potential of grasslands' ecosystem services and enabling comparison of different grassland types and evaluation of management practices.

An online self-learning platform[2] was created by the LIFE Viva Grass project team to ensure long-term sustainable use of the Viva Grass tool. It includes highly illustrative texts with presentations and self-directed practical guidance to understand the concept of ecosystem services and integrated planning. Everyone can easily learn how to use the basic functionalities of the Viva Grass tool and how ecosystem services supply changes according to the different management practices.

The recommendations presented here have been developed based on the provided results by Viva Grass Tool, the experience of testing the Tool application in the 2 farm case study areas, multi-functional farm management plans as well as several rounds of discussions at various stakeholders' events. The aim of the recommendations is to introduce a wide range of farmers with multi-purpose use of grasslands and highlights socioeconomic benefits of the grassland ecosystem services for farm development by Viva Grass tool.

[1] https://vivagrass.eu/integrated-planning-tool/

[2] https://vivagrass.eu/self-learning-platform/

1. Ecosystem services provided by grasslands

1.1. Grassland benefits

Ecosystem services or the contribution of nature to human well-being are all those benefits that ecosystems (e.g. grasslands, forests, mires etc.) provide to humans, including provisional (goods and products), regulating (benefits from natural processes) and cultural services (non-material benefits).

Grasslands are among the most biologically diverse ecosystems in the world, providing a wide range of ecosystem services essential for human welfare, e.g. biomass production for grazing animals or producing energy, herbs and honey production, genetic resources, carbon storage, flood reduction, erosion prevention, maintaining soil fertility, water infiltration and purification, habitats for pollinators and protected species, beautiful landscape, cultural heritage etc.

Over centuries humans mostly saw the value of grasslands in their ability to provide food for domestic animals. The role of grasslands as fodder providers has decreased nowadays by the transformation of grasslands back into forests or arable land in many places, therefore losing the areas and the quality of this valuable ecosystem. Nowadays, grass may be used for energy production needs, as medical plant for tea production, genetic resource or honey source also other bee products (pollen, ambrosia and propolis).

In the Baltic Region, semi-natural grasslands host up to 700 plant species. Grassland plant species provide habitats for many animals - plenty of insects (butterflies, beetles, grasshoppers, gadflies etc.), various birds (corncrakes, white storks etc.), amphibians (frogs and toads), reptiles (lizards and snakes), soil animals (worms, snails) and various microorganisms.

Grasslands maintains various processes linking together the living (biotic) and non-living (or abiotic) environments such as habitat formation, biomass production, soil formation, energy and matter exchange and food chain. Although these processes are common for different ecosystems, they differ in their performance.

Grasslands provide also physically intangible benefits. These benefits are not usually perceived in everyday life, but they highly improve the quality of human living, for example, Midsummer celebration traditions, creation of folk songs and arts, recreational activities (hiking, animal watching etc.). Grasslands are a significant part of the cultural landscape, which has formed the traditional mosaic living environment over many centuries in Europe.

1.2. Ecosystem service assessment by LIFE Viva Grass project

Ecosystem services can be assessed to show the importance of ecosystems in human life and to the society, by directly measuring and calculating a monetary value or giving an agreed scoring unit. In order to assess the potential provision of ecosystem services in Baltic grasslands, LIFE Viva Grass project has elaborated a specific grassland classification system[3] based on three main factors comprising both biotic and abiotic components: land quality (boniteet), relief features and management regime of the grasslands (cultivated, permanent and semi-natural). Ecosystem service assessed also for arable land (cropland) to compare evaluation to grasslands.

All factors are combined through GIS algebra, resulting in a total of 30 grassland classes plus 10 arable land classes. The ecosystem services matrix is used to assess the potential supply of ecosystem services (5 provisional and 8 regulating services) of agroecosystems (arable land and grasslands) following an expert-based qualitative evaluation[4]. The experts evaluate the potential supply of ecosystem services to land classes on a qualitative scale from 0 to 5 scale, where 0 represents no relevant supply of ecosystem

[3] https://vivagrass.eu/integrated-planning-tool/viva-grass-basemap/

[4] https://vivagrass.eu/integrated-planning-tool/matrix-of-viva-grass-basemap/

services and 5 represents a very high supply of ecosystem services. The cultural ecosystem services provided by grasslands is context-specific and the factors that determine the provision of this set of services often show local-scale differences. Consequently, the Viva Grass methodology evaluates four cultural ecosystem services in the context of each grassland's surrounding landscape and its features. Therefore, cultural ecosystem services are not included in the ecosystem services matrix valuation method and they are evaluated separately.

The LIFE Viva Grass ecosystem service assessment shows a clear difference between the ecosystem services 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 ecosystem services whereas cultivated grasslands show a high potential for provisioning ecosystem services.

Cultivated grasslands where farmers use fertilisers, soil processing and seeding can give a much higher amount of grass biomass compared to semi-natural grasslands. Cultivated grassland provide high supply of provisioning services such as reared animals and their outputs, fodder and biomass for energy and also high supply of filtration process as regulating service, but moderate supply of regulating services such as bioremediation, soil fertility and chemical conditions of freshwaters.

Permanent grasslands are generally defined as land used to grow grasses naturally or through cultivation which is older than five years can better ensure regulation processes compared to cultivated grasslands. Permanent grasslands provide high supply of regulating services such as bioremediation, pollination, filtration process, chemical conditions of freshwaters and control of erosion, but moderate supply of climate regulation, habitats maintaining and soil fertility. Permanent grasslands also provide moderate supply of provisioning services (fodder, biomass for energy and herbs for medicine).

Semi-natural grasslands, especially of a high nature value, are the result of decades or centuries of low intensity management and are currently not seeded or ploughed. These grasslands hold a higher biodiversity. Semi-natural grasslands provide high supply of regulating services such as bioremediation, pollination, climate regulation, habitats maintaining, filtration process, control of erosion and also high supply of herbs for medicine as provisioning service, but moderate supply of soil fertility, fodder, biomass for energy and reared animals and their outputs.

Arable or cropland is defined as intensively managed farmland used for crop production, ploughed at least one time in the season and usually fertilized. Arable land provides high supply of provisional services such as fodder, biomass for energy and cultivated crops, but moderate supply of regulating services such as filtration process and soil fertility.

2. Ecosystem service supply to the site level

The ecosystem service approach offers a holistic view on interactions between nature and humans, thus providing a suitable framework for decision-makers also farmers and landowners to address conflicts and synergies between environmental and socio-economic goals and to find the most appropriate solution for land management.

The Viva Grass online tool[5] allows assessing the provision of ecosystem service by grasslands and arable land in a spatially explicit way. "Viva Grass Viewer" is a public map application oriented to display general information about grasslands type and ecosystem services. By accessing the Viva Grass tool Viewer[6] it is possible to spatially locate grassland classes and the ecosystem service they provide, as well as visualize the potential supply of ecosystem service through bar graphs.

[5] Integrated Planning Tool User Guide. Version 1.1. 2019.

[6] https://tool.vivagrass.eu/vgsites/viewer/

In initial extent of Viva Grass Viewer, there are all Baltic countries displayed and contextual overview layers provided, for example, percentage of permanent grasslands from all agricultural land (Fig.2.1.). Common navigation functions are provided to change map extent and zoom level to specific territory to display land use (grassland) information. Place search functionality are developed to find place name on the map.

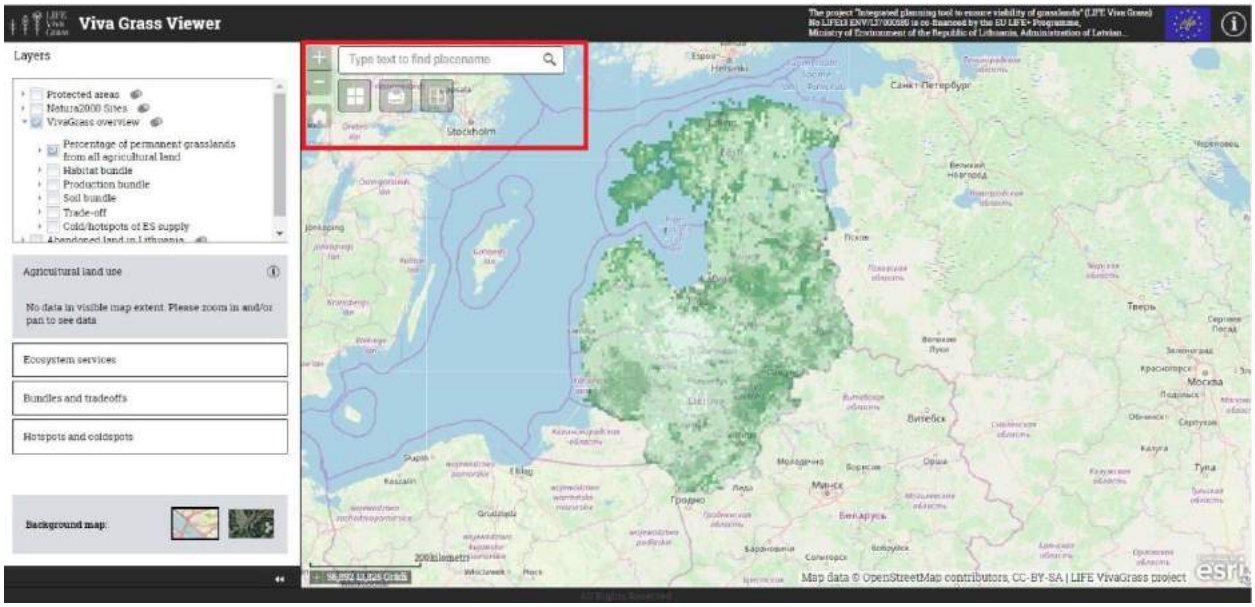


Figure 2.1. Initial extent of Viva Grass Viewer with navigation functions to concrete site.

By clicking on a land block of interest (Fig.2.2.), pop-up window displayed on the right side of the application and the user can view a wide range of ecosystem services provided by the selected grassland. Pop-up window contains location, type and ecosystem services value information. The Viewer module of the Tool provides for any user including land owner or farmer an opportunity to explore more about its fields in terms of production of provisioning services (called as bundle of production), or regulating services (called as a bundle Habitats or a bundle Soil). The user can change the land use type (e.g. from cultivated grassland to semi-natural) to see how it changes the supply potential of ecosystem services. The arrows show how it changes the provision of different ecosystem services. Where available, the management recommendations for this particular grassland type are provided.

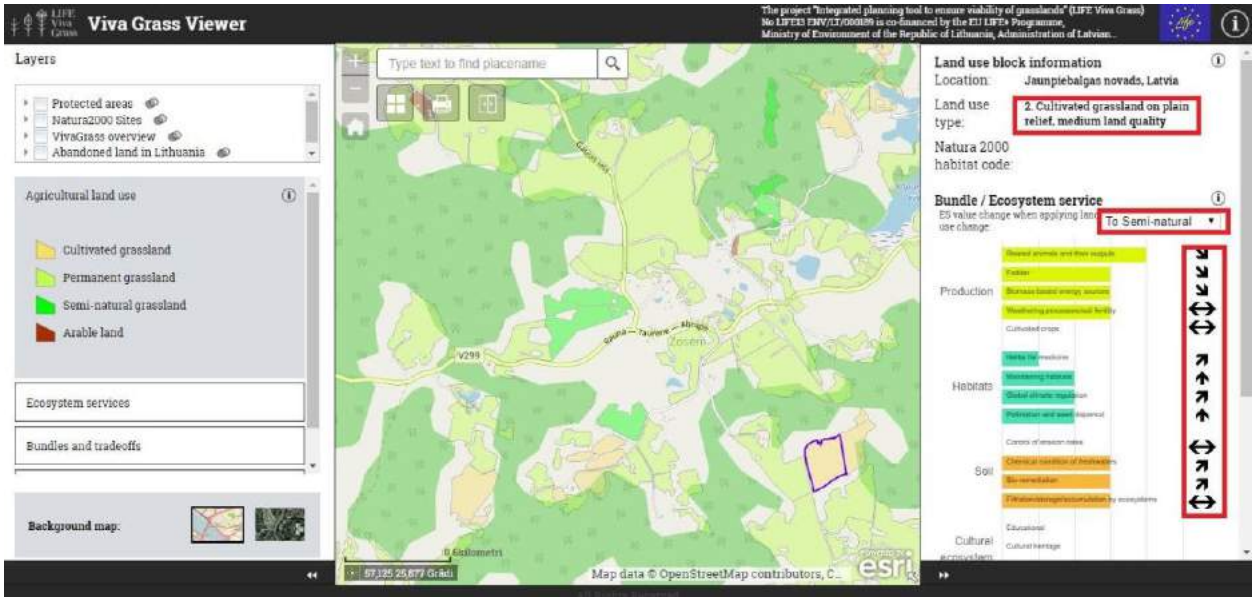
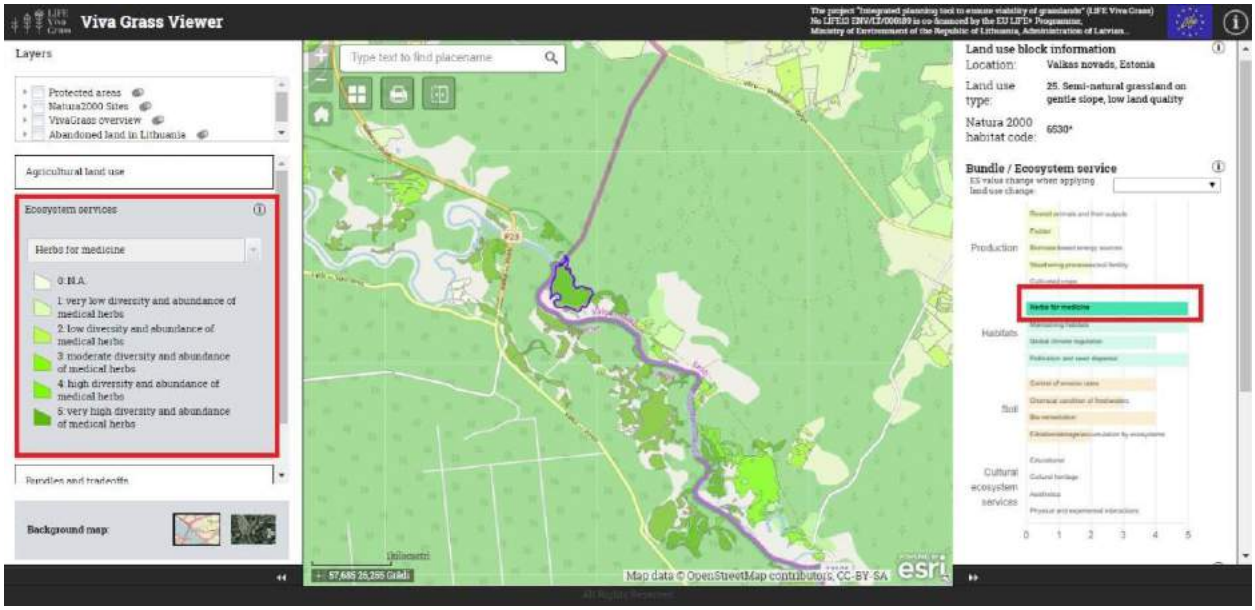


Figure 2.2. Selection of land use block and changes of ecosystem service supply.

The data layer of ecosystem services allows the user to explore mapping and assessment results of selected ecosystem services by choosing one in the drop-down menu. By selecting certain ecosystem service from the drop-down menu on the left side (Fig.2.3.), the user can see the provision (distribution and value) of this ecosystem service in different land blocks. The dark green colour shows higher provision of the selected ecosystem service in this case – Herbs for medicine.

Figure 2.3. Distribution and value of selected ecosystem service.



3. Application of Viva Grass Tool recommendations for scenario development

3.1. Overall explanation of Viva Grass Tool recommendations

Application of the ecosystem service approach in rural support policy would facilitate integration of ecological principles into agricultural practice and increasing the efficiency and multi-functionality of the agricultural measures applied to grasslands. By analysing differences in ecosystem service provision in various grassland types, farmers can plan the most appropriate agricultural land use structure to satisfy economic, social and environmental needs.

LIFE Viva Grass project has elaborated many types of grasslands for ecosystem service assessment. Although, most of them provide the same set of ecosystem services, their values are different. The benefits which can be obtained from each grassland depend on its natural characteristics, but also the selected management approach. Therefore, recommendations related to grassland type and ecosystem service values are prepared based on the results provided by the Viva Grass Tool (Fig.3.1.).

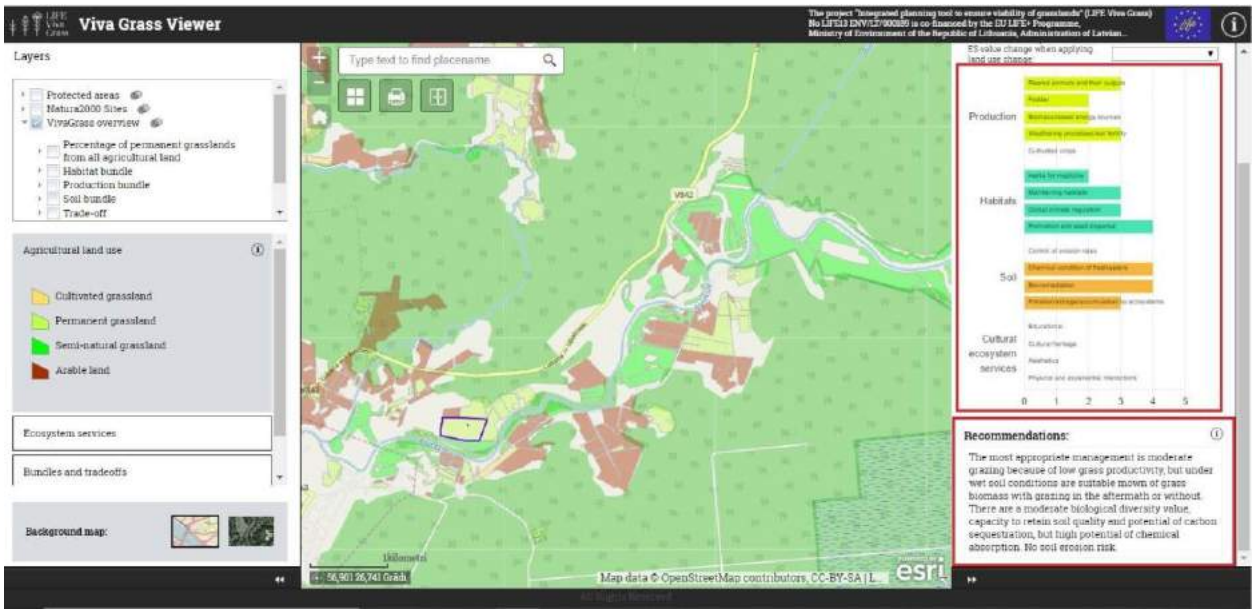


Figure 3.1. Management recommendations based on the results provided by the Viva Grass Tool.

Recommendations consists of short overall information of suggestions for management options which highlights important ecosystem services based on their values. The recommendations give overall environmental understanding and characterize benefits of land blocks. Additional management recommendations (Fig.3.2.) are developed for semi-natural grassland block based on Protected habitat management guidelines for Latvia[7]. All recommendations are short summaries of the most important management and ecosystem service values, therefore overall recommendations for all land use classes are prepared: "*Management measures must be evaluated and selected, depending on the territory and the situation, taking into account cultural and historical aspects, as well as development strategy of the specific site*".

[7] https://nat-programme.daba.gov.lv/public/eng/documents_and_publications/

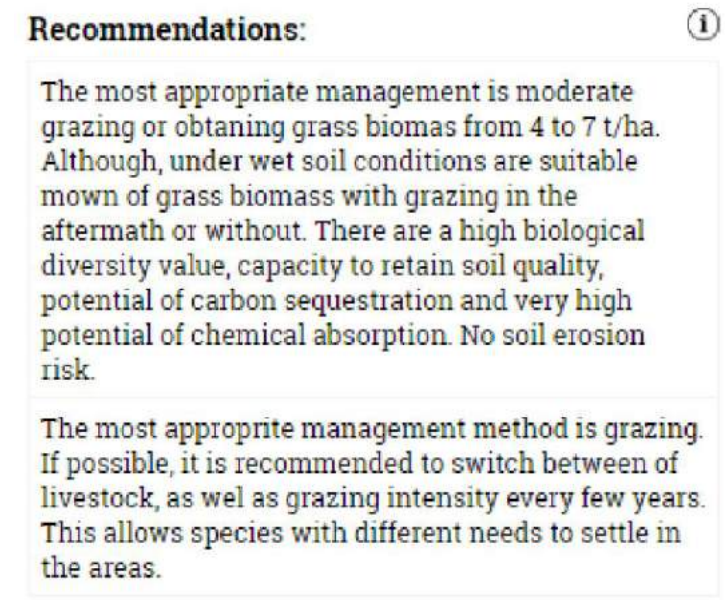


Figure 3.2. Additional recommendations for protected habitat management.

3.2. Examples of management scenario development

A scenario can be defined as a description of possible future situations, including path development leading to that situation. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of possible future and to draw attention to the key factors that will drive future developments. The Viva Grass Viewer module includes a basic impact assessment of land use change scenarios as primary land management option (Fig.3.3.). The assessment presents a trend with arrows of land use change between different agro-ecosystem categories (bundles) on supply of provisioning and regulating ecosystem services. Combination of primary management options and Viva Grass Tool recommendations is needed for start of scenarios development for the most appropriate multi-functional farm management.

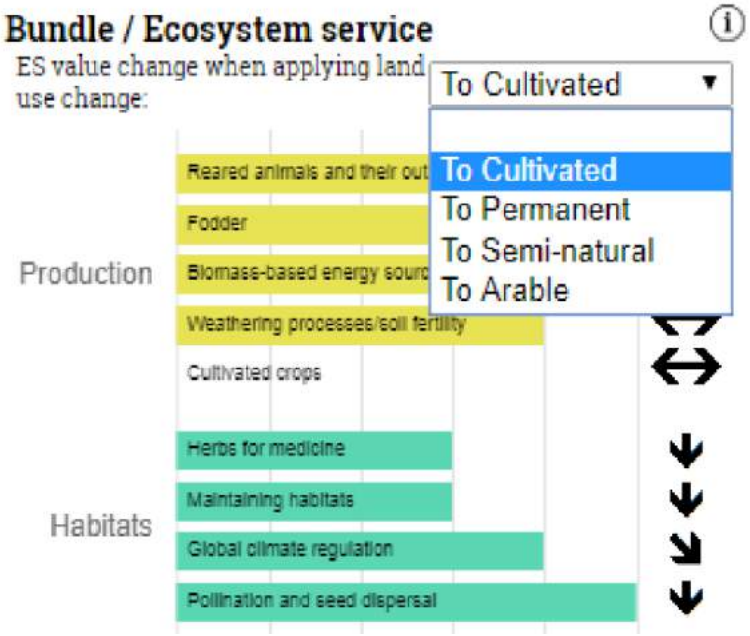


Figure 3.3. Land use change scenarios between semi-natural and cultivated grassland

The first example: Arable land on gentle slope in low land quality

The land plot is located on undulating relief with low land quality, soil fertility and used for intensive agriculture. Such intensive land management is not ensuring wide range of ecosystem service benefits, but just delivers two provisioning services with moderate productivity of biomass (Fig.3.4.). Current land use – arable land – can supply production of bioenergy resources or animal food with moderate output from 4 to 7 t/ha. The area is not recommended for crop production. Biological diversity is very low, capacity to retain soil quality and impact on climate regulation is low as well. Although, the area is important for cultural and aesthetic service supply.

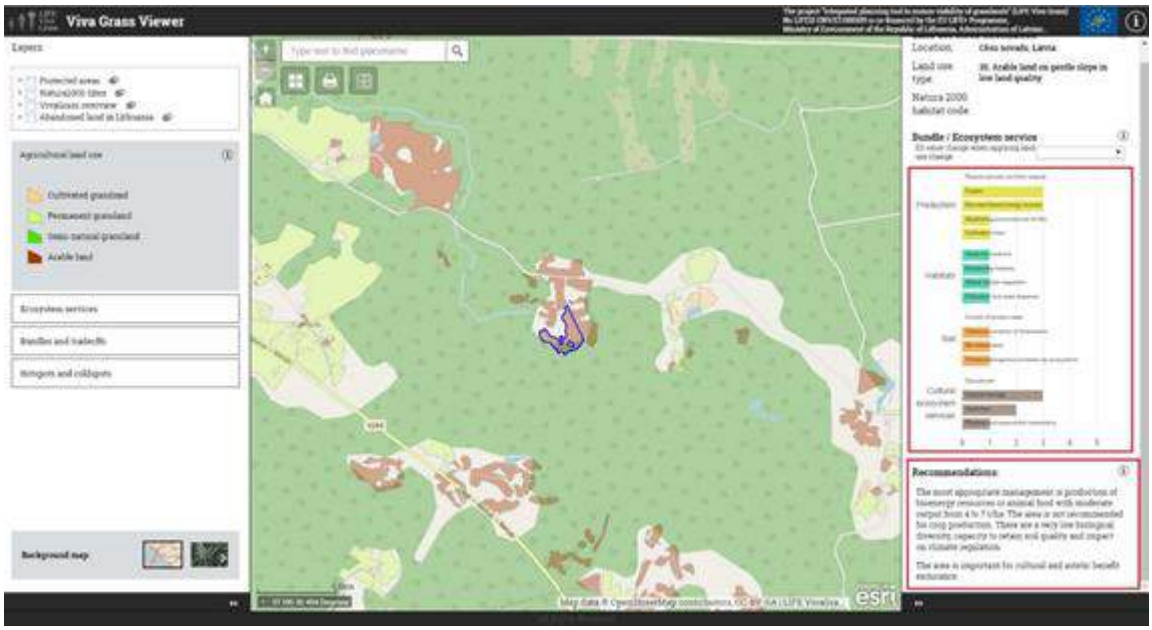


Figure 3.4. Arable land on gentle slope in low land quality

Table 1. **Arable land management versus alternative land uses**

Ecosystem service	Value	To Cultivated	To Permanent	To Semi-natural
Cultivated crops	1	↑	↘	↘
Reared animals and their outputs	0	↑	↗	↗
Fodder	3	↘	↘	↘
Biomass-based energy sources	3	↘	↘	↘
Herbs for medicine	1	↔	↑	↑
Bioremediation	1	↗	↗	↑
Filtration/storage by ecosystem	1	↘	↗	↗
Control of erosion rates	0	↗	↑	↑

Pollination and seed dispersal	1	↗	↑	↑
Maintaining habitats	1	↗	↑	↑
Soil fertility	1	↗	↗	↗
Chemical condition of freshwaters	1	↗	↗	↗
Global climate regulation	1	↗	↗	↑

Symbol meanings: ↑ - strong increase; ↗ - slight increase; ↔ - no impact; ↘ - slight decrease; ↓ - strong decrease

Land use change scenarios show possibilities to deliver higher supply of provisioning and regulating ecosystem services for this area (Table 1). In this case, the Viva Grass Tool reveals that land, which based on its agro-ecological conditions would be more suitable for maintaining semi-natural or permanent grasslands, is used as arable land or cultivated. The extensive management of permanent or semi-natural grasslands is strongly increasing provisioning of herbs for medicine, bioremediation process, control of erosion rates, pollination and seed dispersal, climate regulation and biodiversity from habitat maintaining. Almost all ecosystem services are increasing their supply only three services are decreasing by ensuring lower yield and grass productivity. This is mainly due to low land quality, what must be taken into account for future land management options.

The second example: Permanent grassland on plain relief, high land quality

The managed land is located on plain relief with high land quality, soil fertility and used for extensive agriculture. Such management decision is ensuring wide range of ecosystem service benefits with moderate and high values (Fig.3.5.).

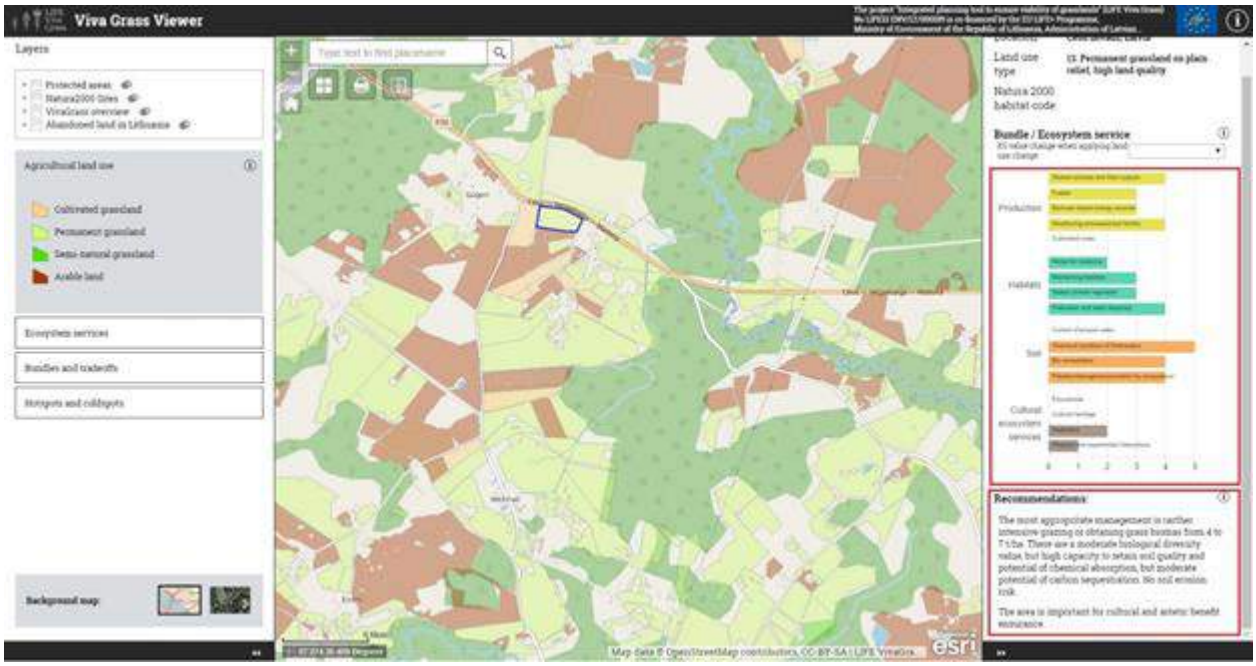


Figure 3.5. Permanent grassland on plain relief in high land quality.

Current land use – permanent grassland – provides is beneficial for rather intensive grazing or obtaining grass biomass from 4 to 7 t/ha. The managed land delivers a moderate biological diversity value and potential of carbon sequestration, but high capacity to retain soil quality and potential of chemical absorption. There is no soil erosion risk, as well as the area provides cultural and aesthetic value. The area has a potential for several land use and management options.

In this example, land use change scenarios show possibilities to choose also other land use categories and deliver mostly the same or lower supply of provisioning and regulating ecosystem services for this area (Table 2). In this case, the Viva Grass tool reveals that land is suitable for maintaining permanent grasslands based on its agro-ecological conditions. The extensive management of semi-natural grasslands are only slightly increasing few ecosystem services - provisioning of herbs for medicine, bioremediation process, pollination and seed dispersal, climate regulation and biodiversity from habitat maintaining. Semi-natural grassland management does not impact a larger part of ecosystem services in these agro-ecological conditions. If more intensive management practises will be chosen and land cover will be changed to arable or cultivated grassland, a larger part of ecosystem services will slightly decrease and only few services will slightly increase by ensuring higher yield and grass productivity. This is mainly due to relief conditions and high land quality to be considered for future land management options.

Table 2. **Permanent grassland management versus land use change scenarios**

Ecosystem service	**Value**	**To Arable land**	**To Cultivated**	**To Semi-natural**
Cultivated crops	0	↗	↔	↔
Reared animals and their outputs	4	↘	↗	↘
Fodder	3	↗	↗	↔
Biomass-based energy sources	3	↗	↗	↔
Herbs for medicine	2	↘	↘	↗
Bioremediation	4	↘	↘	↗
Filtration/storage by ecosystem	4	↘	↔	↔
Control of erosion rates	0	↔	↔	↔
Pollination and seed dispersal	4	↓	↘	↗
Maintaining habitats	3	↓	↘	↗
Soil fertility	4	↘	↔	↔
Chemical condition of freshwaters	5	↘	↘	↔
Global climate regulation	3	↘	↘	↗

Symbol meanings: ↑ - strong increase; ↗ - slight increase; ↔ - no impact; ↘ - slight decrease; ↓ - strong decrease

4. Analysis of farm development scenarios with Viva Grass tool

4.1. Overall explanation of decision-making tools

Viva Grass Viewer offers an easy-to-use decision-making support tool for ecosystem service-based land use planning at local scale: bundles, trade-offs and 'hot-spot' & 'cold-spot' analysis. This information layer calls landowners to reconsider the current land uses and future management options.

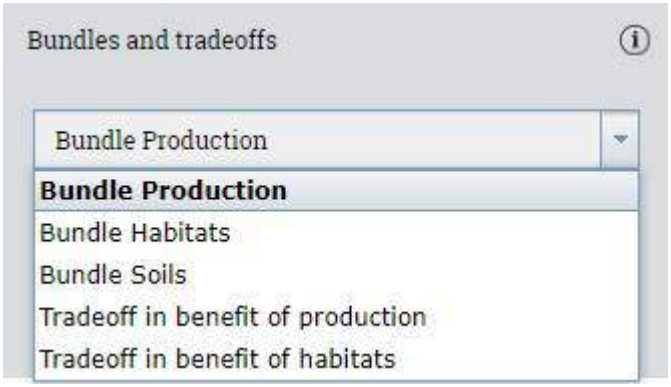


Figure 4.1. Bundle and trade-off tools displayed in Viva Grass Viewer.

Bundles and trade-offs of ecosystem services represent spatial grouping and interactions of ecosystem services (Fig.4.1.). The user is able to explore these groupings and interactions by choosing one of them in the drop-down menu. The increase of one service in the bundle usually means also increase of other services belonging to the bundle.

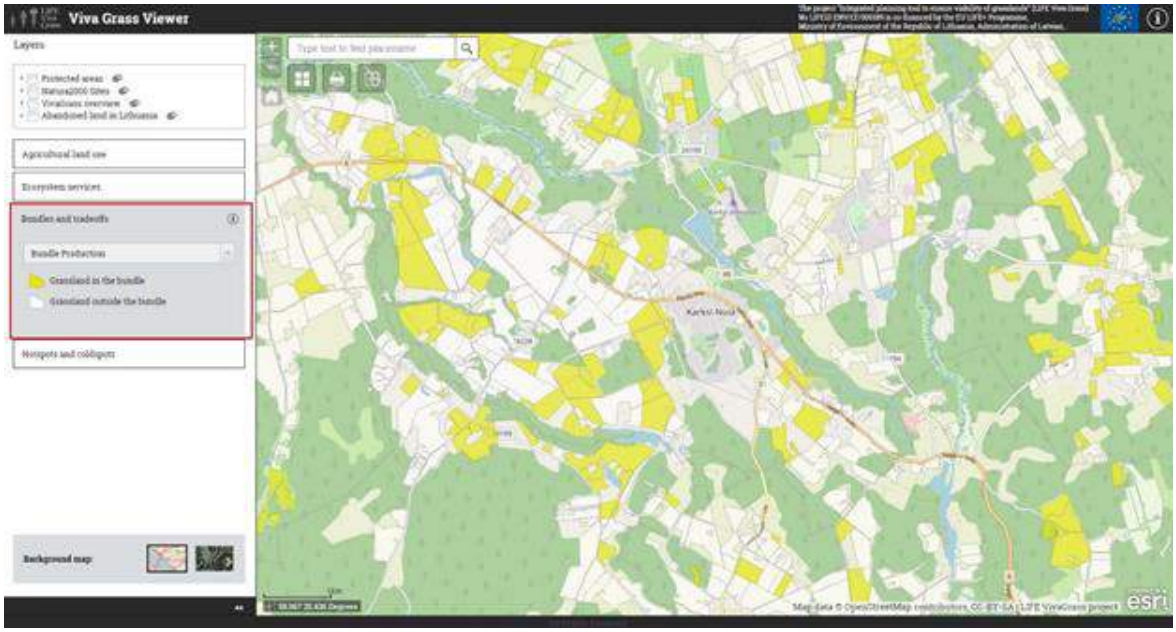


Figure 4.2. Grasslands belonging to the "Production" bundle.

"Production" bundle includes 4 ecosystem services related to the productivity of ecosystems: Reared animals and their outputs, fodder, biomass for energy and cultivated crops. All these ecosystem services are based on biomass production. Therefore, the increase in one of the services in this bundle usually means an increase in others. However, biomass for energy not only depends on the productivity but also on the calorific potential of grassland species. Grasslands belonging to the "Production" bundle (Fig.4.2.) ensure provisional ecosystem services such as hay for animal fodder or grass biomass for energy.

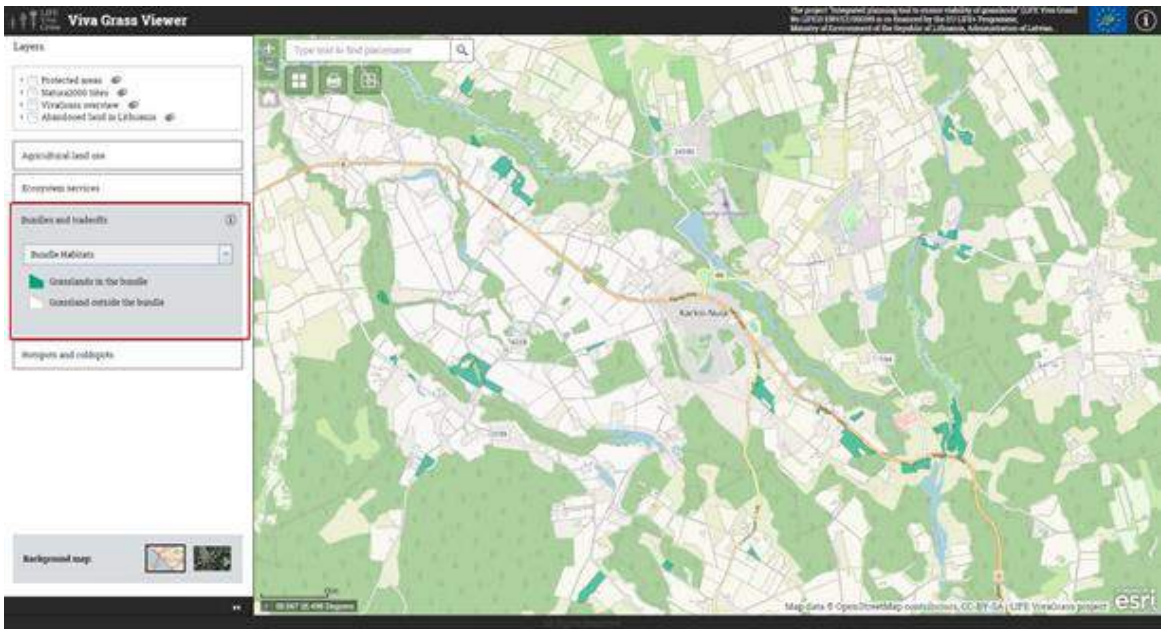


Figure 4.3. Grasslands belonging to the "Habitats" bundle.

"Habitats" bundle includes 4 ecosystem services: Herbs for medicine, pollination and seed dispersal, maintaining habitats and global climate regulation. For example, in species rich grasslands, we are likely to find a wide range of herbs with a medicinal value. The grassland management practices that aim to increase biodiversity, such as the reduction or complete elimination of ploughing and fertilization, also increase pollination or ecosystem services supporting climate regulation. Grasslands belonging to the "Habitats" bundle support preservation of biodiversity and related ecosystem services (Fig.4.3.).

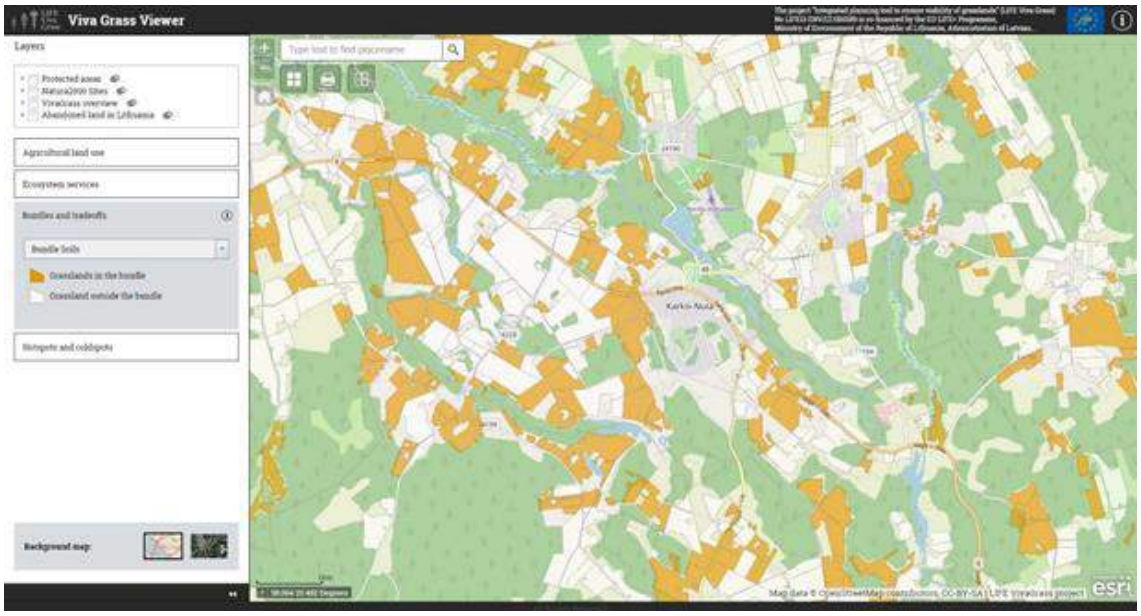


Figure 4.4. Grasslands belonging to the "Soils" bundle.

"Soils" bundle includes 5 ecosystem services related to the role of soil in ecosystem processes: Control of erosion rates, chemical condition of fresh waters, bioremediation, filtration/storage/accumulation by ecosystems and weathering processes or soil fertility. Grasslands belonging to the "Soils" bundle ensure ecosystem services related to the prevention of environmental risks and improvement of land and soil quality (Fig.4.4.).

Trade-offs occur when 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 another service. Visualisation of the trade-offs of the ecosystem services supply resulting from different land use alternatives – e.g. turning a permanent grassland into a cultivated grassland increases the production of grass biomass, but decreases the ecosystem services related to biodiversity and natural processes, e.g. medical herbs, pollination, climate regulation.

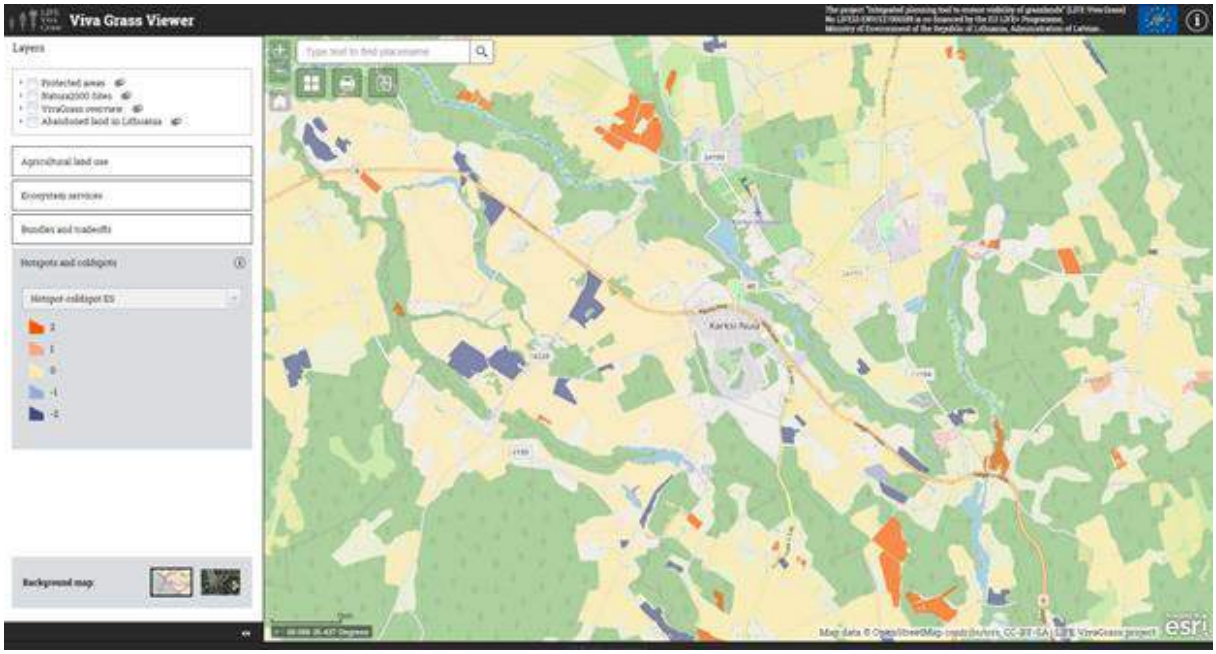


Figure 4.5. 'Hot-spot' & 'cold-spot' areas

'Hot-spot' & 'cold-spot' analysis within the Viva Grass tool (Fig.4.5.): cold-spot areas are areas where a great number of services are provided at low or very low values; hot-spot areas in contrast offer a great number of services at high or very high values. The user is able to explore different representations of cold-spots and hot-spots of ecosystem services by choosing one from the drop-down menu. Hot-spots are vulnerable to intensification of agriculture due to the good agro-ecological conditions and cold-spots are farmland where use is not suitable for given agro-ecological conditions.

Identification of the hot-spot areas with high potential of ecosystem services helps to find the most valuable ecosystems and to ensure their preservation whereas cold-spot areas with low potential of ecosystem services helps to find degraded ecosystems or areas with inappropriate agricultural management practices from environmental as well as from socio-economic point of view.

4.2. Example of Kurese nature farm

Kurese nature farm was one of pilot areas for testing the Viva Grass tool on a farm level and the results were used for development of the management plan. The Kurese nature farm, located in West-Estonia, Pärnu County, was established in order to restore and preserve the cultural and natural values of the former Kurese village. A larger part of the farm is located within the boundaries of the Kurese Landscape Protection Area and a great share of it is semi-natural grasslands managed by cattle grazing. The main idea of farm is to ensure sustainable management of grasslands to combine organic beef farming, nature conservation, and, possibly in the future, nature tourism with appropriate management measures.

The farming systems characterized by ecosystem services configuration require specific management practices. Therefore, decision-making support tools (Bundles, trade-offs and 'hot-spot' &

'cold-spot' analysis) were used for appropriate management practise development. Those are visually expressed datasets, that the project team developed when analysing different grassland management scenarios and use-cases of Viva Grass Tool. They provide a wider context and help analyse ecosystem service-based information about grasslands easier and from different perspectives.

Figure 4.6. Grasslands in Kurese farm belonging to the habitats bundle.

Bundle analysis shows that most of the area in Kurese farmland belongs to the habitats bundle (Fig.4.6.), formed by four ecosystem services: Herbs for medicine, maintaining habitats, global climate regulation, pollination and seed dispersal. The southernmost part of the Kurese farm belongs to the soils bundle (Fig. 4.7.). The ecosystem services that form this bundle are related to the role of soil functions and environment quality regulation processes in ecosystem: bioremediation, filtration/storage/accumulation, chemical condition of fresh waters and weathering processes/soil fertility. None of Kurese farm field belongs to production bundle. Trade – off analysis of Kurese farm confirms bundle analysis results.

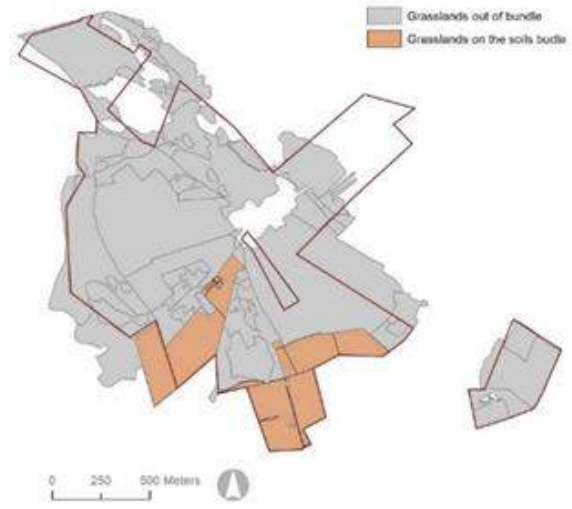


Figure 4.7. Grasslands in Kurese farm belonging to the soils bundle.

"Trade-off in benefit of habitats" (Fig.4.8.) represent the fields where high values of habitats diversity and maintenance ("Habitats" bundle) occur simultaneously with low values on biomass production ("Production" bundle). This means that increasing grassland production would decrease the benefits of biodiversity and environmental quality. 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. A larger part of Kurese farm grasslands' hot-spots provided with great number of services by high and very high values.

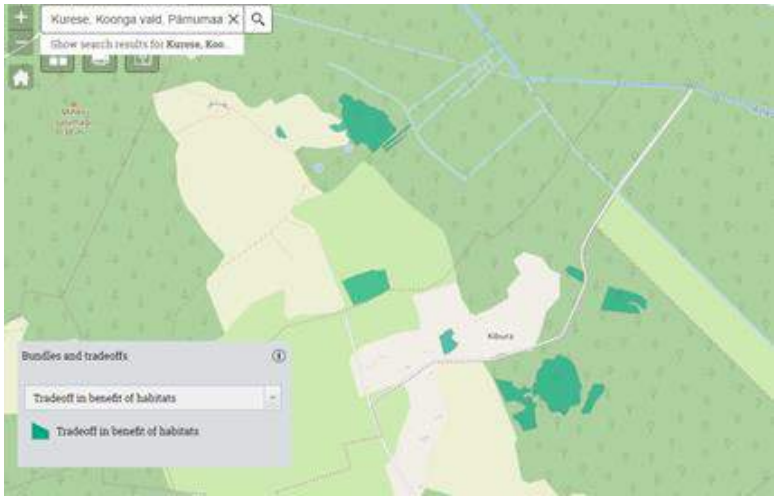


Figure 4.8. Trade-off in benefit of habitats in Kurese farm.

Summarizing all results from decision-making support analysis recommendations are developed for appropriate grassland management measures. Kurese nature farm is advised low intensity grazing, alongside with grazing rotations and to switch between of livestock. This allows species with different needs to settle in the areas. Mowing of grass biomass are suitable under wet soil conditions in some areas of the farm. Soil protection practices are also important in order to avoid degradation and erosion processes.

5. Farm development based on socio-economic benefits provided by the grassland ecosystem services

5.1. Socioeconomic benefits of the grasslands

The consideration of grasslands as socio-ecological systems seems crucial to acknowledge the human component needed for their maintenance and hence for the generation of ecosystem services[8] [1]. Socio-ecological systems able to deliver a multiplicity of services beyond provisioning marketed services largely coincide with low agricultural inputs, low stocking densities and often labour-intensive management practices. Particularly important are the small-scale farming systems that are responsible for creating and maintaining the species-rich semi-natural grasslands, which are often true hot-spots for biodiversity.

Management of social-ecological systems requires understanding both the biophysical constraints that create trade-offs among ecosystem services and human values to understand the preferences of the farmers and the services that contribute to their well-being. "Social-ecological" services can reinforce the importance of human culture, perspectives, and economies to the production

[8] Vareka, E., Robles-Cruz, A. B. 2016. Ecosystem services and socio-economic benefits of grasslands. http://om.ciheam.org/om/pdf/a114/a114.pdf

of ES and change the conception that rather than thinking of something coming from an ecosystem has value. Assessment of trade-offs among services and the implications these trade-offs have for social well-being have been based on assessing projected changes in land use.

Therefore, the maintenance of grasslands is important not only for agricultural production, but also for public benefits such as a healthy environment and social well-being. The benefits which can be obtained from each grassland areas depend on its natural characteristics but also the selected management approach. In order to find the most profitable solution, not only beneficial for the economy but also for the environment, economic and well-being of society, various factors (biological, geographical, socio-economic etc.) must be taken into account.

LIFE Viva Grass experience uptake from Europe as well as best practice examples from the Baltic States show that economic viability of grassland management can be increased by supporting the multifunctional use of grasslands, diversification of income from different grassland products and provided services, as well as strengthening the cooperation networks among the farmers in grassland management, new product development and marketing, as well as development of local supply chains.

The aim of the LIFE Viva Grass project in both farms is to demonstrate different sustainable grassland management scenarios based on the socio-economic situation and environmental factors in the concrete area with long-term management measures. The farm management plans were made in order to ensure management of grassland as a social-ecological system with maintenance of the ecosystem services after project end.

5.2. Example of Šovītes farm

Farm “Šovītes” was one of the case study areas for testing the Viva Grass Tool on a farm level and the results were used for development of the management plan. Farm "Šovītes" is located in the central part of Latvia, Vecpiebalga municipality. The territory of the farm is ca. 120 ha, out of which about 85 ha are grasslands and the remaining part is covered by forests. Farm “Šovītes” grasslands are managed by cattle grazing. The farmer was interested to apply sustainable, nature friendly farming practices in order to maintain landscape and biological assets of the area at the same time producing high value meat products. Additionally, economic aspects play a significant role – the owner has calculated that natural self-sustaining grassland requires less investment in a long-term compared to a cultivated grassland.

According to the assessment of the current ecosystem services supply, the area of the farm "Šovīte" is suitable for livestock farming and for the production of forage or other biomass products. The area is suitable for moderate intensive grazing and cannot provide high biomass production under natural conditions. At present grasslands are not biologically diverse, so the supply of medicinal plants is not high. The area is not suitable for growing crops due to the mixed terrain and low soil fertility. The Viva Grass Tool shows high supply of pollination, bioremediation and regulation of chemical conditions of freshwater in the area of the farm “Šovītes”. Grasslands provide erosion control on steep slopes. The area does not have a high biodiversity value and is therefore not of high value as a habitat for different species. The aesthetic value of landscape is significant here. This is due to the undulating terrain of the area and the open view of Lake Gulberis as well as the naturalness of the area. Recreational and educational services have low value at the moment.

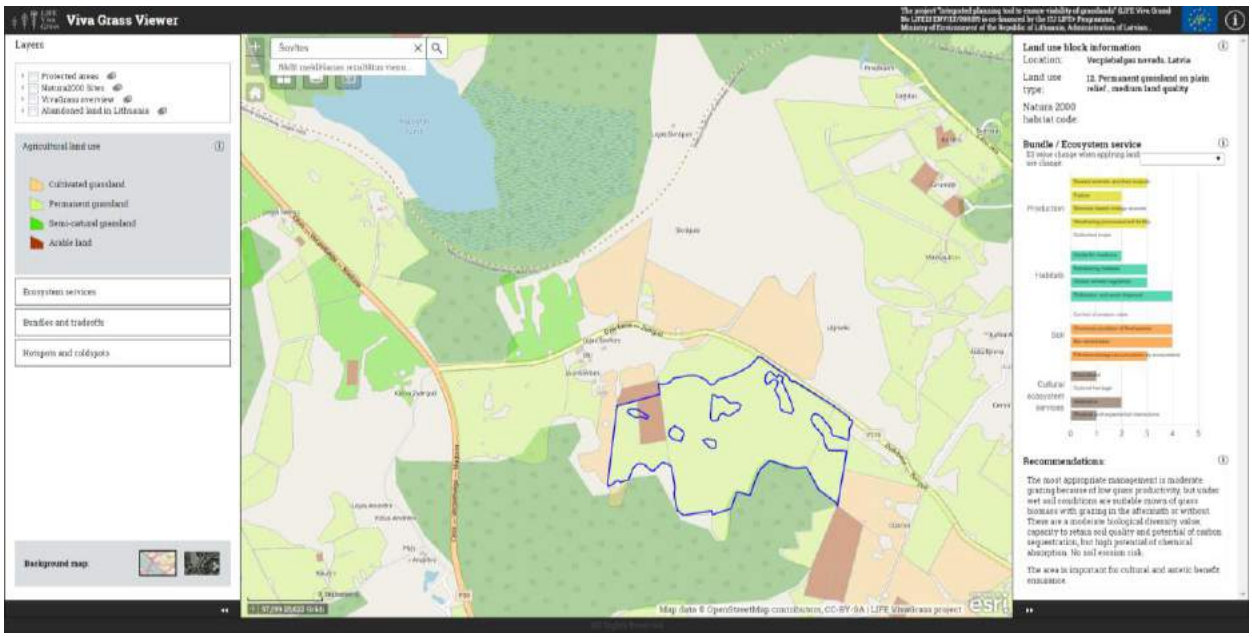


Figure 5.1. Example of Šovītes farm on assessment of the current ecosystem services supply of one of the fields.

Bundle analysis shows that most of the area in Šovītes farmland belongs to the soil bundle and only few fields belongs to the production bundle. Trade-off analysis confirms that the fields where high values in “Production” bundle occur have simultaneously low values in “Habitats” bundle. The intensive grazing practices have turned simplified structure of grasslands and decrease of the number of grassland species in the existing habitats in the farm “’Šovītes”. The hot-spot areas are the most valuable ecosystems with high potential of ecosystem services and most of grasslands are an important part of them in farm “Šovītes”.

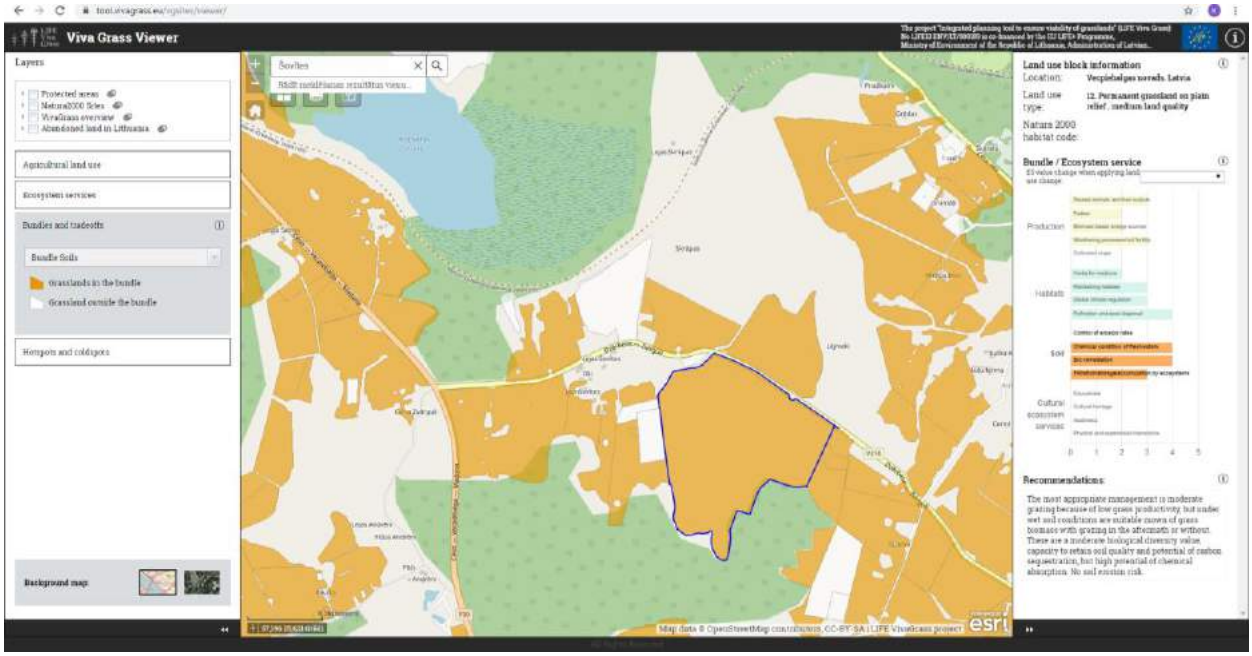


Figure 5.1. Example of Šovītes farm on assessment of the current ecosystem services supply related to soil bundle.

The farmer's choice of the most suitable management practices and grassland related land use determines also how and for what to apply the Viva Grass tool's functionality. After evaluation all Viva Grass Tool results, owners of farm "Šovītes" together with the project team developed farm four business scenarios related to grassland management: beef cattle breeding, selective cattle breeding, forage production and harvesting semi-natural grassland seeds. SWOT (Strong and Weak points, Opportunities and Threats) analysis was implemented for all four potential business scenarios including aspects on economic costs and benefits. All scenarios were analysed by gross coverage method and labour-intensive grassland management option evaluation. At the final stage with Viva Grass Planner[9], assessment of four potential farm business scenarios impact on ecosystem service changes was created by prioritization model. Another potential scenario was added to the assessment: land abandonment and non-management.

The results of the scenario assessment show that a significant improvement of ecosystem service supply in farm "Šovītes" grasslands can be provided by the development of forage and grass biomass production or the choice of a new business direction in favour harvesting semi-natural grassland seeds (Table 3.). The beef cattle breeding or the selective cattle breeding will not significantly improve the amount ecosystem service supply, but they can contribute to increasing biodiversity. A negative impact on existing ecosystem service supply can be caused by the cessation of management and abandonment of the site.

Table 3. **Assessment of changes in ecosystem services under different development scenarios.**

Ecosystem service	**Beef cattle breeding**	**Selective cattle breeding**	**Forage production**	**Harvesting semi-natural grassland seeds**	**Land abandonment**
Cultivated crops	=/↑	=/↑	↓	↓	↓
Reared animals and their outputs	↑	↑	↓	↓	↓
Fodder	=/↓	=/↓	↑	↓	↓
Biomass-based energy sources	↓	↓	↑	↑	↓
Herbs for medicine	=	=	↑	↑	↓
Bio-remediation	=	=	↑	↑	=
Filtration/storage by ecosystem	=	=	=	=	↓
Control of erosion rates	=/↓	=/↓	↑	↑	↑
Pollination and seed dispersal	=	=	↑	↑	=/↑
Maintaining habitats	=/↑	=/↑	↑	↑	↑

[9] https://vivagrass.eu/integrated-planning-tool/vivagrass-planner/

Soil fertility	=	=	=	=	=
Chemical condition of freshwaters	=	=	=	=	=
Global climate regulation	=	=	=	↑	↑
Recreational value	=	=	=	=	=
Educational value	=	=	=	=	↓
Cultural heritage value	=	=	=	=	=
Aesthetics value	=	=	=	↑	↓
ES changes	+3/-3	+3/-3	+7/-2	+8/-3	+4/-8
Sum	0	0	+5	+5	-4

↑ - an increase in the current supply of ecosystem services based on development scenario changes

↓ - a decrease in the current supply of ecosystem services based on development scenario changes

= - there is little or no change in the current provision of ecosystem services based on development scenario changes

At the end of the project, the farmer considered to change the business model of farm "Šovītes" from pure beef breeding and grassland management to diverse grassland related businesses according to the developed multi-functional business plan. The future of farm "Šovītes" is related to selective cattle breeding, forage production and harvesting semi-natural grassland seeds.

General recommendations

- Geographical location and characteristics are important preconditions for the selection of the direction of development of the farms which set out the possibilities and limits for scenario-development. At the same time, a set of environmental conditions for the site also create preconditions for more diverse management and business opportunities. Viva Grass tool helps in a relatively easy way to understand farmlands' agro-ecological conditions and identify appropriate management options based on ecosystem service concept.
- The ecosystem service concept helps to realise the different benefits provided by grasslands and thus increase the multi-functionality, promoting diversified income opportunities, as well as demonstrating the cooperation potential, since production of ecosystem services usually goes beyond the single farm.
- It is essential to choose an adequate direction of the farm development in a way that will enhance ecosystem service supply from the managed areas and ensure the multiple benefits for farmer as well as for society. Understanding of grasslands as socio-ecological systems could help to find the best annual and long-term management measures with lowest inputs delivering multiple ecosystem benefits to society.
- It is necessary to choose a management option which does not require investment in resource-intensive activities in order to ensure the economic viability and sustainability of a small or medium-sized farm whose future plans do not significantly increase the number of employees and managed land areas.
- Applying the ecosystem services concept in development and branding of new grassland products should be promoted, like, synergies from cattle breeding in semi-natural habitats and the supply of other ecosystem services can be highlighted in marketing the milk and meat products.
- Applying new approaches and innovative solutions requires new knowledge and skills, therefore capacity-building of farmers should be promoted on integrated planning, ecosystem service and environment quality issues.