

Summary

LANDSCAPE AND GREEN INFRASTRUCTURE REGIONAL PLAN FOR ZEMGALE PLANNING REGION

SIA Delta Kompānija
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ENGRAVE



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1 The structure of the thematic plan

Landscape and Green Infrastructure Plan for Zemgale Planning Region (ZPR) is designed as the assessment of the landscape and green infrastructure in 2019, outlining actions and governance solutions to enhance landscape qualities.

The structure of the thematic plan consists of:

- Overview of binding documents and regulations;
- Description of the approach for landscape assessment at regional level;
- Assessment of typological units of ZPR's landscapes and their description;
- Characterization and assessment of the features of ZPR's landscape regions: land use / land cover mosaic, cultural heritage, specially protected nature protection areas;
- Assessment of hydrology, water resources and fish and bird species in the Lielupe Catchment Area;
- Assessment of ecosystem services in ZPR;
- Assessment of landscape diversity and values of ZPR's landscapes at the regional scale;
- Assessment of green infrastructure in Zemgale Plain Landscape Region;
- Elaboration of green infrastructure scenarios for Zemgale Plain Landscape Region;
- Assessment of landscape qualities and the identification of landscape quality objectives for ZPR's regional landscape units;
- Assessment of landscape qualities and the identification of landscape quality objectives for Zemgale Plain Landscape Region's sub-regional landscape units;
- Recommendations to enhance governance of landscape and green infrastructure in ZPR;
- Guidelines for landscape planning at the local scale (for local municipalities).

The key issues of the thematic plan include recommendations for landscape assessment and planning at the regional scale, the use of ecosystem services approach to assess the state of green infrastructure, identification of landscape quality objectives and place-based actions, development of green infrastructure scenarios at the sub-regional level, as well as recommendations for landscape governance at the regional level.

2 The overview of binding documents and regulations

Landscape policy in Latvia is based on the international document-agreement, European Landscape Convention (ELC), ratified by the Saeima in 2007 and the consequential Landscape Policy Guidelines (LPG) for 2013-2019, developed by the Ministry of Environmental Protection and Regional Development.

The ELC landscape definition emphasizes that (1) landscape is both a territory and its perception, (2) landscapes are formed over a long period of time, (3) landscapes should be defined both by locals and landscape visitors. The Convention defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors".

The European Landscape Convention is designed as a new policy instrument to promote institutional and research co-operation on various issues related to landscape protection, management and planning. The Landscape Policy Guidelines (LPG) primarily emphasize the need for targeted governance of landscape change to identify the potential of Latvia's landscapes and to ensure its sustainable implementation according to the expectations of society.

The landscape change governance in the LPG has three levels – the national and the regional level, which regulates and ensures the protection and preservation of landscapes of national significance and / or the protection of its individual elements (natural or cultural monuments) in the form of laws, guidelines and recommendations. both the implementation of practical landscape change and quality improvement activities and the provision of a legal framework for the management of landscape change in the form of various spatial plans (including thematic plans) by key stakeholders - state, municipal, private and public organizations, individuals.

Because it is the local level where the real issues arise, conflicts arise, the restrictive or non-adaptive nature of various laws and regulations is identified with regard to specific cases, and any landscape change failures are most directly felt, and a framework for their alignment, open to continuous peer review and a flexible process of change. It is for these reasons that the Latvian Landscape Policy Guidelines indicate that it is advisable to carry out landscape assessment and the development of general landscape plans as one of the first stages of spatial development planning.

In Latvian planning legislation (Territorial Development Planning Law), landscape assessment and general plans can be made within the framework of thematic planning. Various site-specific landscaping solutions can be legitimized by developing local plans.

3 Landscape assessment approach

A spatial unit of a landscape (region, sub-region, area) is a scale dependent territorial unit that is similar in terms of its structure, functions, visual form, course of historical development. For ZPR landscape classification two approaches were used: typological and territorial.

The most important aspects:

- such an approach identifies the variety of landscape types and their territorial boundaries and distribution as further instrumental planning units.
- it is a way of describing the territory as a whole (not just its individual elements).
- the approach allows to understand the diversity of the region's landscapes and helps to strengthen the understanding of this diversity by the assessment of territorial identity based on the specific characteristics and values of regional landscapes.
- the approach allows to use landscape characteristics in the decision-making process (eg, developing landscape development recommendations, developing criteria for landscape re-creation), as well as to involve stakeholders in the assessment of landscape values.

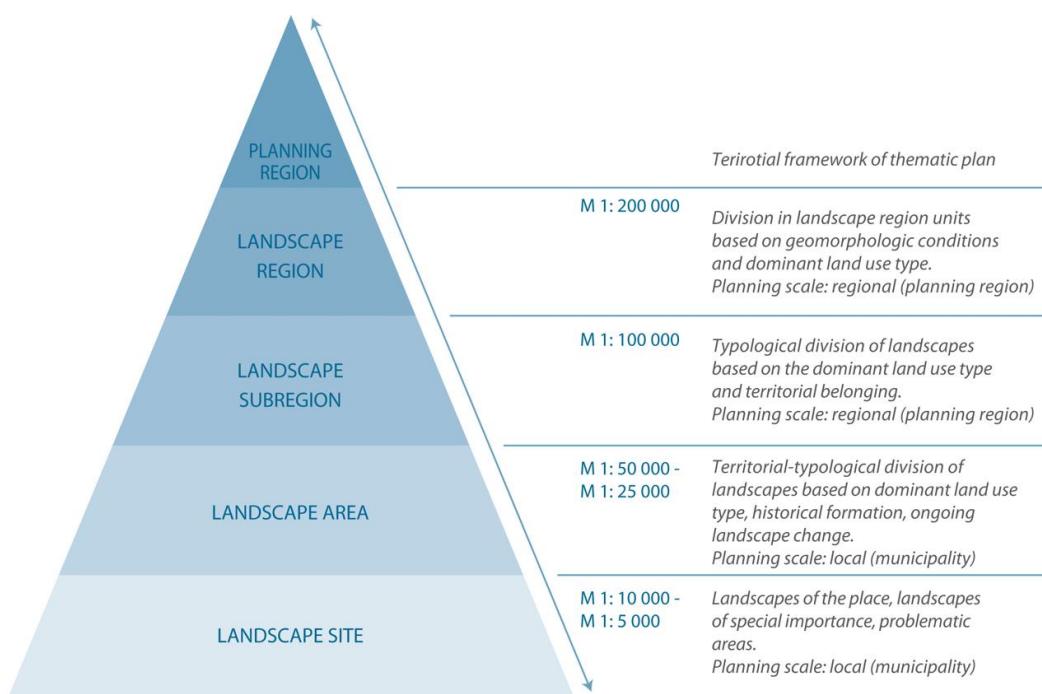


Figure 3.1. Spatial devision of landscapes in regional, subregional and local scales.

Landscape regions are defined by two main characteristics – landforms and land cover / land use mosaic. Natural conditions (relief forms, soils and water conditions) play an important role in the use of the territory and the formation of the landscape - they form

the basis for the spatial structure of the landscape. In turn, cultural forms characterize the nature of landscape use (population, land use, peculiarities of spatial structure). The interaction of natural conditions and cultural forms is manifested in a visual form of the landscape, which can be characterized by the visual characteristics of the region and the aesthetic quality of the landscape.

Landscape regions as large territorial units play an important role in regional landscape governance (as they transcend local administrative boundaries), as well as in the assessment and planning of ecosystem services and green infrastructure networks at the region level.

Landscape sub-regions mark functionally homogeneous landscape units at the regional scale. These landscape units are distinguished based on similar land use types and territorial belonging, including territorially united areas of valuable landscape elements. At the sub-regional scale urbanized landscape units are distinguished, which, although territorially relatively small, are important nodes of historical landscape values. The main types of subregional landscapes consist of agricultural landscapes, mixed agro-forested landscapes, forest landscapes, wetland landscapes and urbanized landscapes.

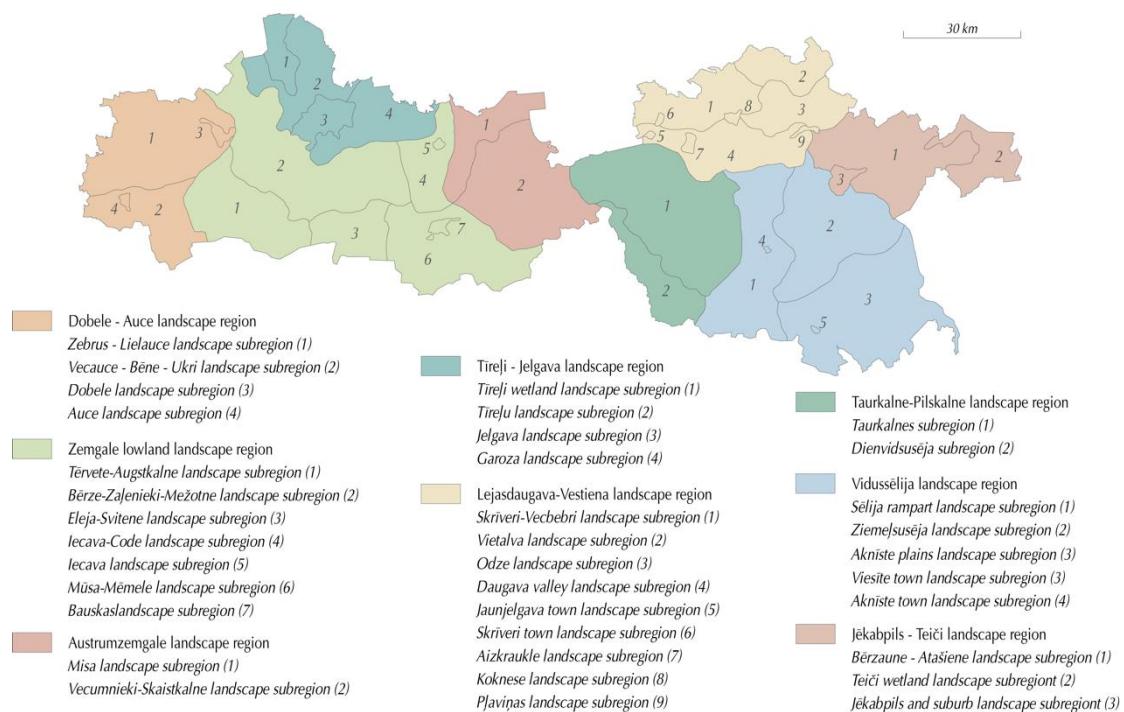


Figure 3.2. Zemgale planning region's landscape regions and subregions.

4 Landscape character and values at the regional scale

4.1 Land cover / land use mosaics

To analyse landscape mosaics Corine Land Cover data was used. It combines the information on land cover and land use (LULC). The LULC mosaic i.e. spatial structure in landscape regions, highlights regional specificities of regional landscape types – landscapes dominated by forests, agro-landscapes or mixed agro-forest landscapes. The spatial structure has been interpreted using the matrix-patch-corridor model. The spatial structures of the LULC have been used in the assessment of the ecosystem services of the ZPR (see section 5).

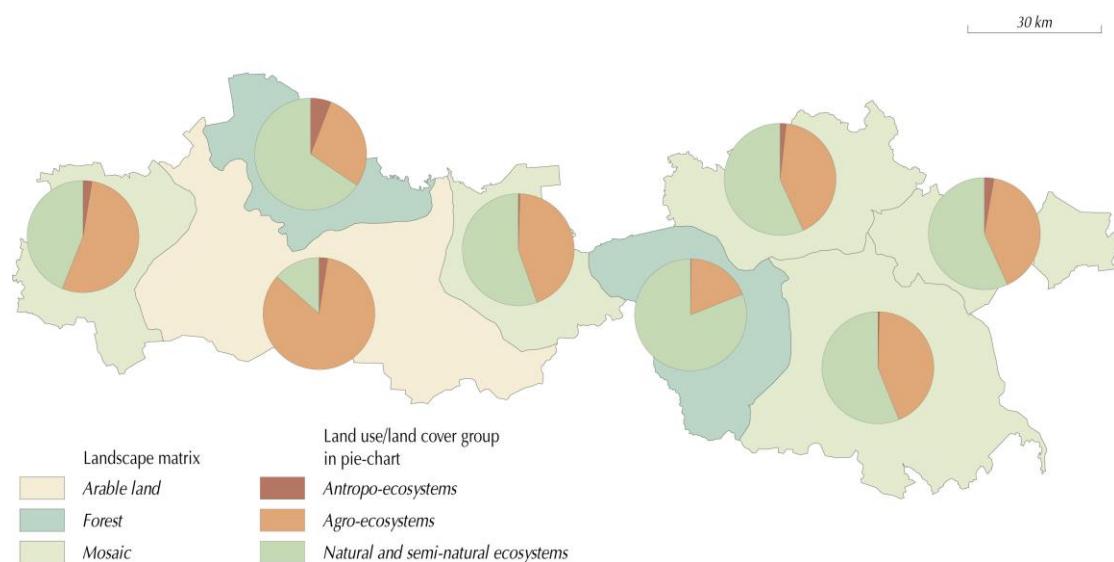


Figure 4.1. Landscape ecological division of Zemgale planning region

4.2 Specially protected natural areas

A large number of specially protected natural areas (SPNA) are located in the territory of ZPR: one national park, one nature reserve, 55 nature reserves, eight nature parks, 46 nature monuments and 382 micro-reserves (see Figure 4.2). They are designed to safeguard and maintain biodiversity of nature – rare and typical ecosystems, habitats for rare species, landscapes, that are peculiar, beautiful and characteristic for Latvia, geological and geomorphological formations, as well as territories, significant for recreational and educational purposes.

The SPNAs, in general, are relatively evenly distributed in the region (with the exception of the Zemgale Plain Landscape Region): the territorially largest SPNAs are located in the Vidussēlija Landscape Region, in particular, in the marshy forests of Ziemeļsusēja Landscape Subregion. While in five landscape subregions (Bērze-Stalģene, Iecava-Code agro landscapes, Dienvidsusēja Lower Reach, Vietalva agricultural landscape and Misa forest landscape) they are practically absent. In terms of the density of distribution, the

SPNA is the most in the Jēkabpils-Teiči landscape region (more precisely, in the Teiči wetland landscape area). Micro-reserves are most common in ZPR forest areas.

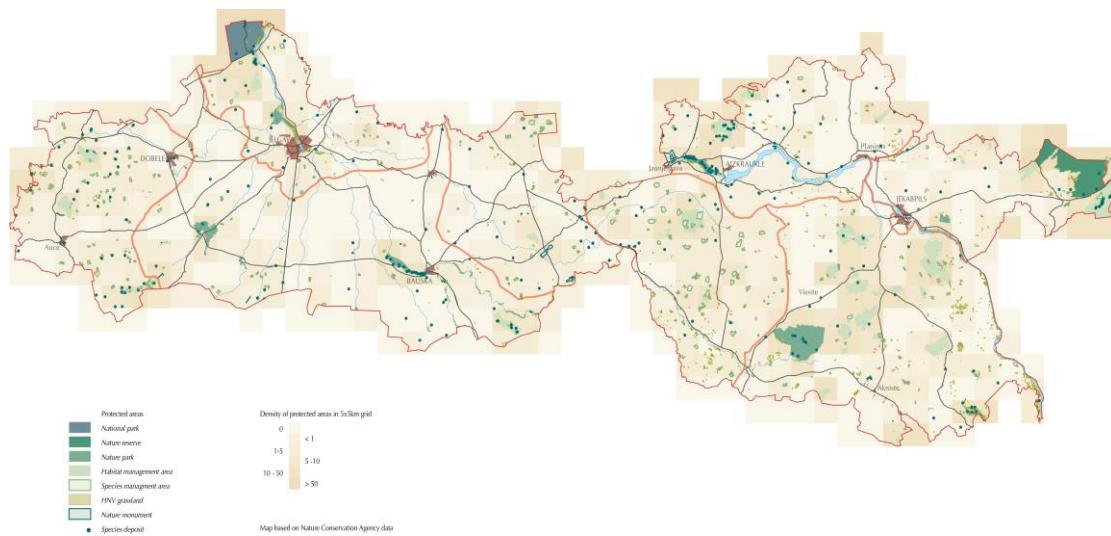


Figure 4.2. Protected areas of Zemgale planning region

4.3 Cultural heritage

Within the framework of the thematic plan, cultural heritage elements were mapped and characterized throughout the Zemgale planning region. The map of cultural heritage consists is based on the typological groups that are under the protection of National Cultural Heritage Agency (NCHA). The monuments are grouped according to the main categories: archaeological, architectural, industrial, urban planning, historical, historical sites and architectural (related to urban planning).

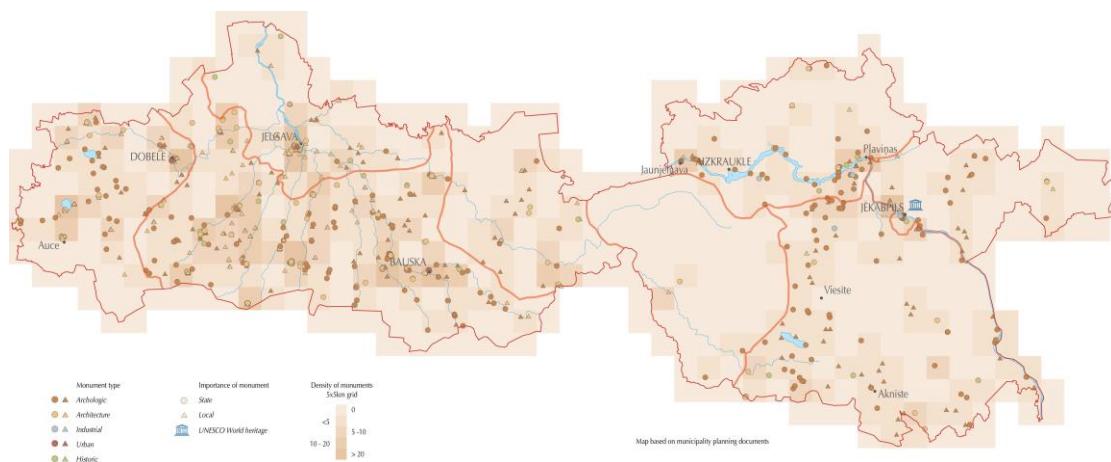


Figure 4.3. Cultural monuments of the Zemgale Planning Region.

Cultural heritage monuments are characterized in the territory of ZPR in general (Fig. 4.3) and in landscape regions (Fig. 4.4) based on three perspectives: cultural heritage as a visual landscape element, cultural heritage as a tourism resource and historical landscapes.

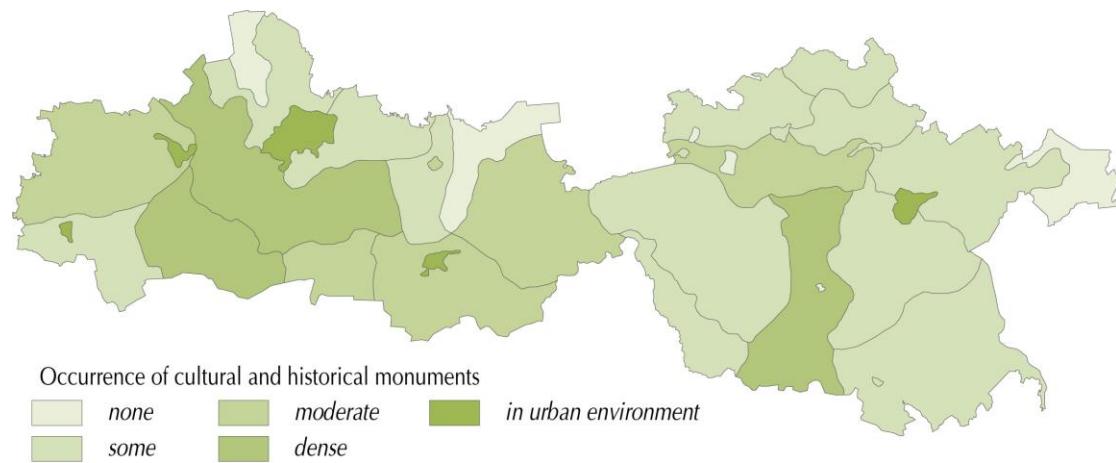


Figure 4.4. Proportion of cultural monuments in the Zemgale Planning Region's landscapes.

Cultural heritage as a visual landscape element. Landscape elements associated with the visually significant cultural monuments, such as churches, manor complexes, mills, parks, castles, bridges, castle ruins, etc. (architectural monuments) and (castle mounds and medieval castle ruins (archaeological monuments) were mapped and characterized.

Cultural heritage as a tourism resource. Most of the tourist attractions and destinations in the ZPR are directly related to the cultural heritage monuments that are under the protection of NCHA. Three of the ZPR culturally valuable landscapes – Tērvete castle mound, Rundāle castle and Koknese castle ruins – are included among the 100 most important sightseeing places in the Baltic States. Rundāle Castle and Tērvete Nature Park are also among the 'Top 10' holiday destinations in Latvia, according to Latvia Travel data base. Latvian Cultural Map includes many tourism routes that are connected with ZPR's cultural monuments.

Cultural heritage as cultural landscape of national and regional value. Cultural heritage landscape in the framework of the plan is defined as an area in which a particular combination of natural features, and historically significant man-made landscape elements and structures can be found. In ZPR at least four nationally important cultural landscape areas can be distinguished:

- Cultural heritage space of the Zemgale castle landscapes of Zemgale castle landscape, which includes Rundāle, Mežotne, Kaucminde, Bauska castles and related landscape elements (e.g., gardens, roads);
- Cultural heritage space of Tērvete historical landscape, which includes elements of from different time periods.
- Cultural space of Koknese castle ruins (together with the Destiny Garden, Koknese manor).

- Historical heritage space of Ložmetējkalns, which is an important Latvian battlefield, located in the wooded area.

4.4 Visual, historical and nature values

Visual, historical and cultural values are distinguished and mapped (Figures 4.5 and 4.6) based on the following criteria:

Visual and historical landscape values

- Institutionalized (protected) landscape values: nature parks, national parks, "Landscape Treasures" at the national and regional scale (<https://ainavudargumi.lv>);
- Large river valleys with historical settlements, diverse nature elements, historical heritage (including cultural monuments), as well as outstanding scenic landscapes. These are: river valleys of Daugava, Lielupe, Mūsa, Mēmele, Aiviekste, Tērvete and Svēte;
- Natural and historical heritage landscape values in diverse locations. These are: open agro-landscape of Zemgale, Zebrus-Lielauce hilly lake landscape, hilly landscapes of Sēlija and Madona-Trepe;
- Landscapes of significant cultural and historical heritage values: Tērvete historical landscape, landscape of castles and manors (surroundings of Bauska, Mežotne and Rundāle), historical landscape of Daugava valley;
- Old-towns and their centres: Bauska, Dobeles, Jelgava, Jaunjelgava and Jēkabpils;
- Scenic road landscapes.

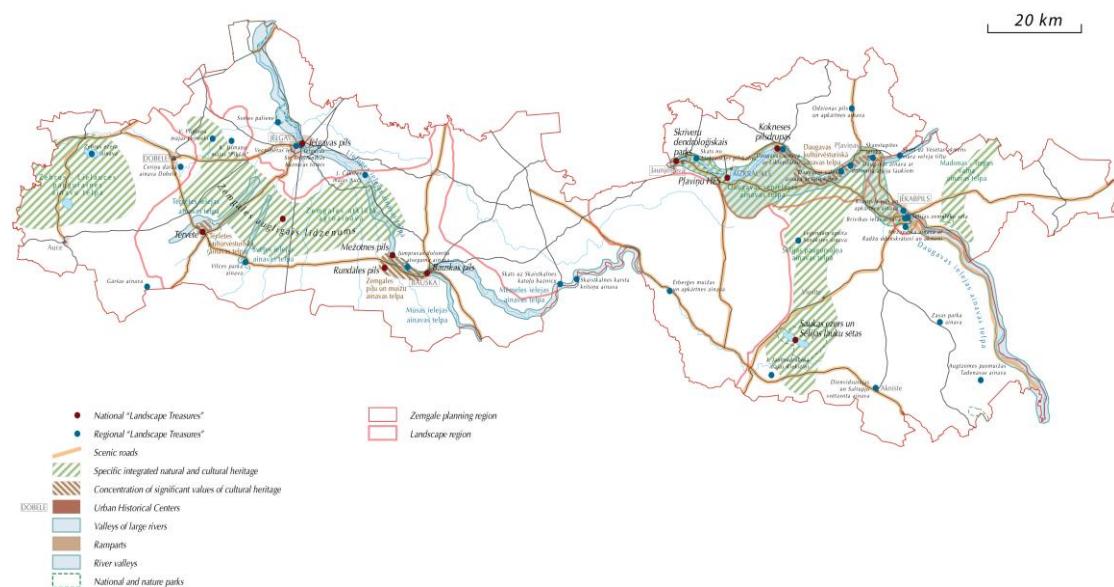


Figure 4.5. Landscape aesthetic and cultural values of Zemgale planning region

Nature values and its diversity

- institutionalized (protected) nature values: nature parks, national parks, nature reserves;
- valleys of large rivers: diversity of natural elements (relief, vegetation);
- continuous wetland landscapes;
- forest spatial structures: hilly forests that form ecologically diverse mosaic-type landscapes, continuous forest massifs;
- The clusters of Zemgale plain forest patches in agroindustrial landscape;
- terraced ancient river valleys and valleys of glacial melting water;
- large lake landscapes;
- inland dune ridges and forests;
- hilly areas as an element of local landscape diversity.

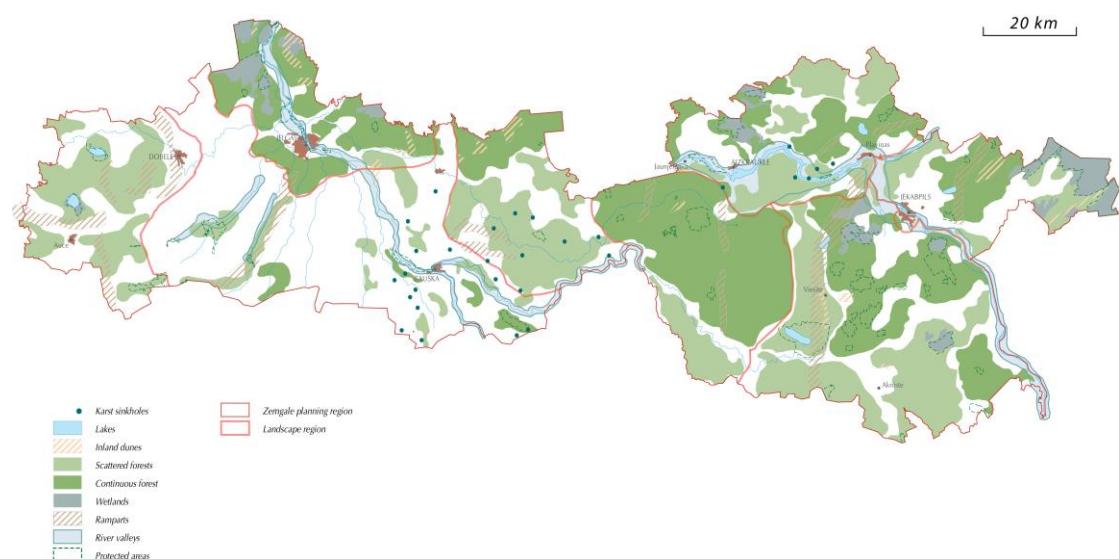


Figure 4.6. Natural landscape values of Zemgale planning region

Great part of cultural and visual landscape value areas and all of the natural landscape value areas are related to green infrastructure, forming significant elements, connections and values of green infrastructure at the regional scale.

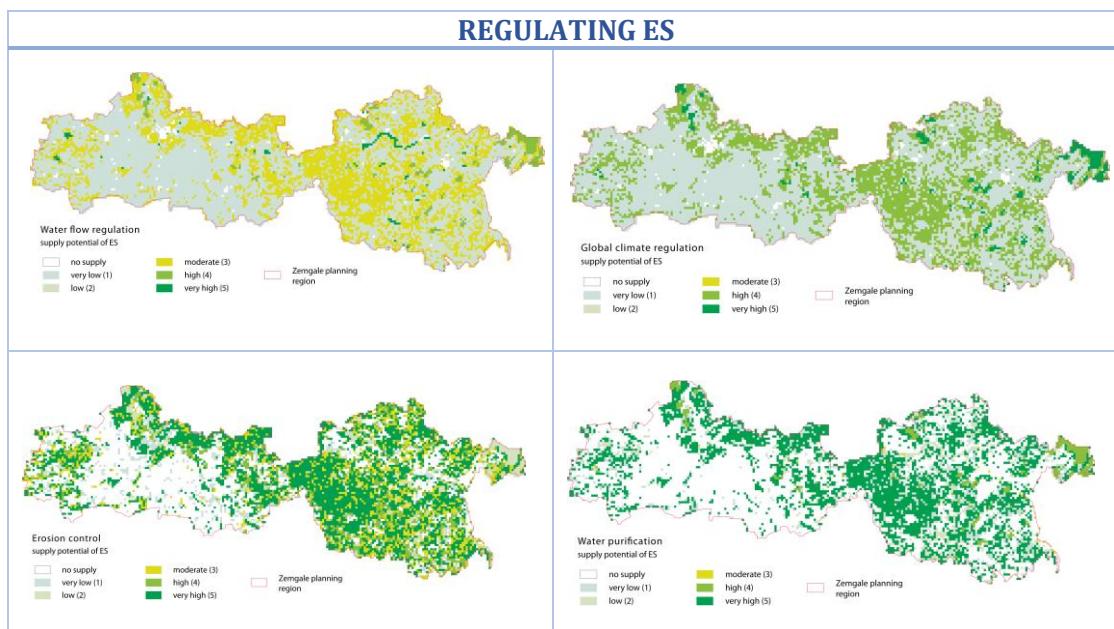
5 Assessment of ecosystem services supply potential

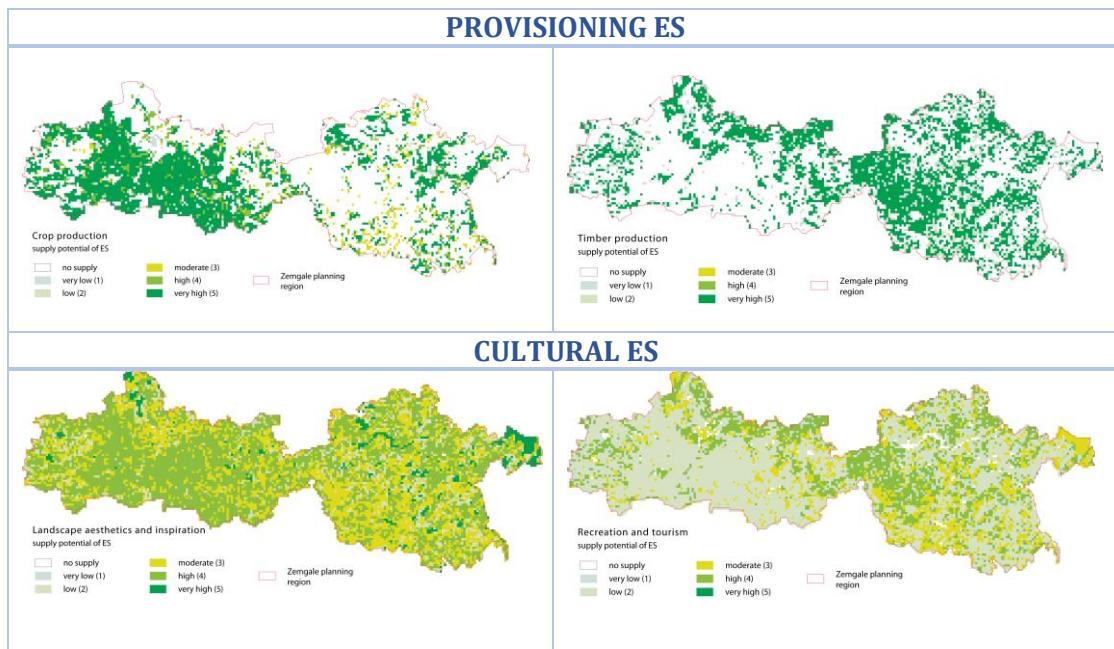
Ecosystem services (ES) are the many and varied benefits that humans receive from ecosystems. ES are divided into four categories:

- Supporting ecosystem services are the basic functions of ecosystems that are a prerequisite for all other ecosystem services, such as soil formation, photosynthesis and biochemical cycles;
- provisioning ES, which directly benefit people and for which market value can be established, such as forage, herbs, genetic resources;
- regulating ES, which are of particular importance to human well-being, such as climate control, pollution reduction, protection against erosion;
- cultural ES, which promotes personal growth, knowledge, aesthetic enjoyment and relaxation, such as landscape and its aesthetic qualities and cultural heritage, providing a basis for recreation and tourism and quality of life in the area.

The potential of the ES was assessed using the so-called matrix method based on the land use/land cover. The table 5.1. summarizes some of the EP values in the ZPR.

Table 5.1. Regulating, provisioning and cultural ES assessment in Zemgale planning region





In order to find out in which areas ecosystem services are inadequately provided, and therefore in which areas planning of GI is required, hot/cold spot analysis (Getis-Ord Gi *) has been carried out, which reveals a probability of a territorial unit ("point", 1x1 km) to fall into the "cold" category – short in regulating ES, or in the "hot" category - regulating ES are provided to a great extent. The results of the analysis show that there is a lack of regulating ES in intensive agricultural areas and major populated areas (towns and cities), which are thus to be classified as priority areas for GI planning.

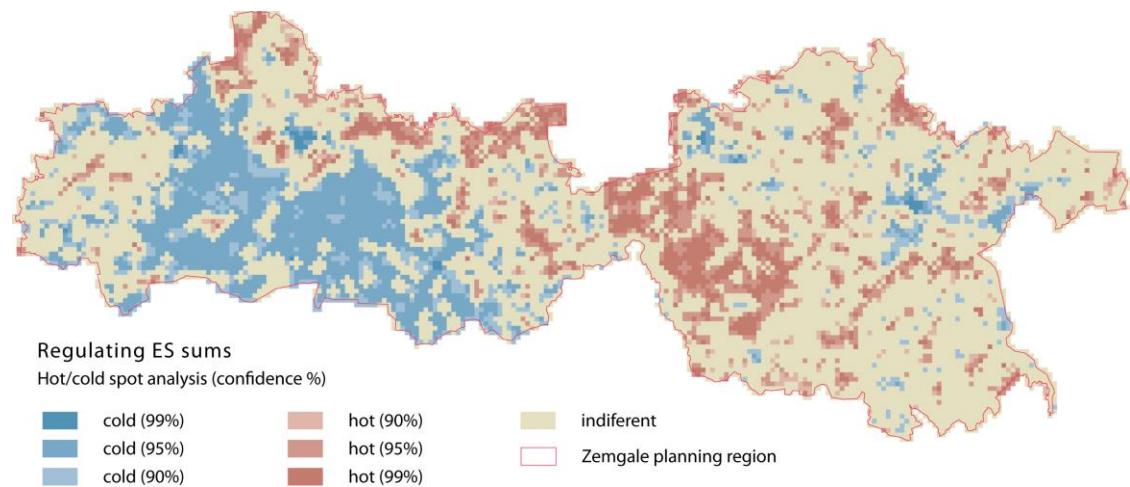


Figure 5.1. Sums of regulating ES in Zemgale Planning Region

6 Evaluation of hydrology, aquatic resources, fish and bird species in the Lielupe river basin

The hydrological characterization of the rivers of Lielupe basin showed that the area's main characteristic is the low steam gradient of the rivers and their slow flow; flood risk areas were identified, concluding that Lielupe River basin, especially in the Zemgale Plains, is the most flood-prone river basin in Latvia. Data and research on river and lake water quality assessment showed that a large part of the catchment area is subject to diffuse and point-type (farm) pollution as well as transboundary pollution.

In general, water quality is low, with high nitrogen and phosphorus saturation, determining the prevalence of the ichthyofauna in the waters of the basin. For example, in the lower and middle reaches of the Lielupe River there are typical limnophilic species – pike, perch, rudd, line, etc., which show the impact of the freshwater ecosystem of Lake Babite on the formation of the ichthyofauna of the Lielupe River.

In Lielupe River basin, with the diversity of landscapes and habitats, the abundance of bird species is generally similar to the average in the country, but some species show a marked concentration of distribution. In the Zemgale Plains, with its relatively homogeneous agro-landscape and habitats associated with relatively intensive agriculture, most species show evasion, while some species, on the contrary, concentrate there. Species, whose distribution is closely related to the Zemgale Plains, are rook, collared dove, ortolan bunting, grey partridge, common quail, common moorhen, European turtle dove, common linnet. Among those species, only common linnet has not shown population decline in the recent years (short term) or in the long term. Bird populations of all open landscape habitats in the Zemgale Plains have decreased.

7 Assessment of landscape diversity at the regional scale

Landscape diversity at the regional scale can be characterized using the typological approach and the distribution analysis of landscape types. Within the ZPR seven landscape types and 11 subtypes can be distinguished, which represent high landscape diversity, formed by both, continuous forest landscapes, continuous agro-industrial landscapes, mosaic-type landscapes in hilly areas and plains. Besides, agro-industrial landscapes are unique landscape types in Latvia. Another landscape types that are of particular value are the ancient river valley landscape and landscapes of wetlands.

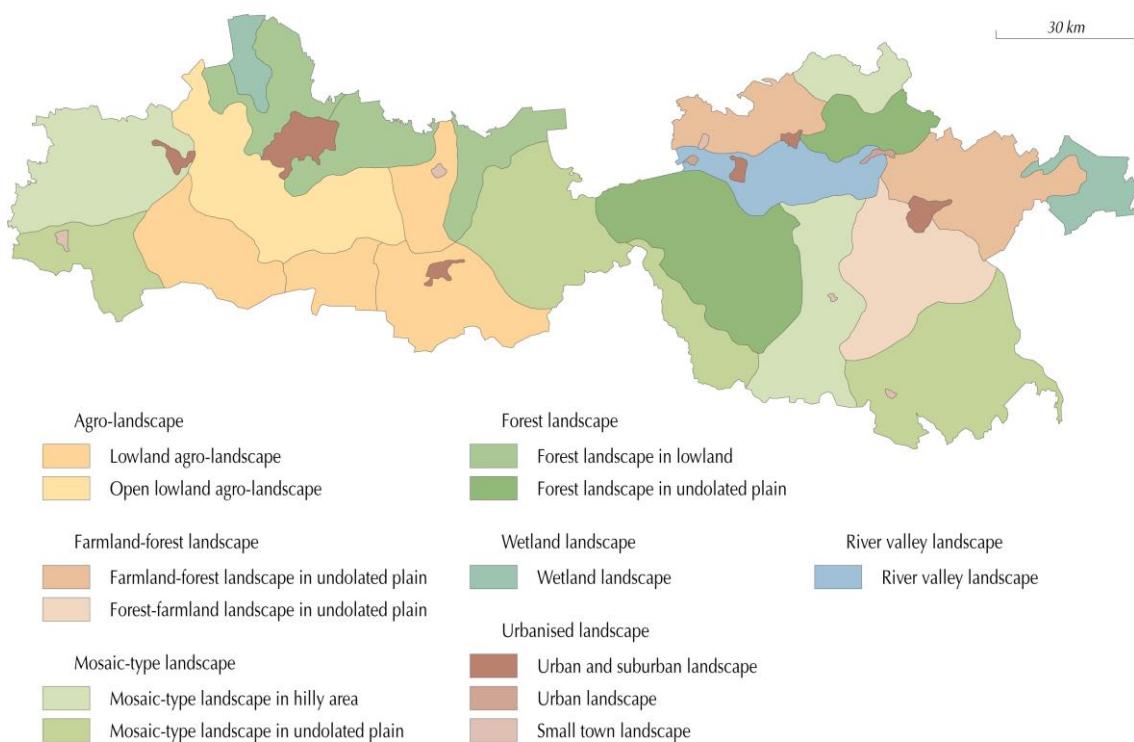


Figure 7.1. Landscape types in the Zemgale Planning Region.

Table 7.1. Landscape types and green infrastructure (GI).

Landscape type	Description	Sub-type	Landscape sub-region
Agro-landscape	Industrial agricultural land dominates, mainly in flat terrain. There are two landscape subtypes in the Zemgale plain: lowland agro-landscape, where the relief is slightly wavy, creating a greater diversity of landscape elements (also, higher proportion of forest patches), and open agro-landscape, which is formed on flat terrain and landscape diversity is mainly determined by	Lowland agro-landscape	Tērvete-Augstkalne, Eleja-Svitene, Mūsa-Mēmele and Iecava-Code agro-landscape
		Open agro-landscape	Bērze-Stalīgne agro-landscape

	the distribution of settlements, agro-industrial units, and road network.		
The share of GI in the open agro-landscape is small, while in the lowland agro-landscape it varies from medium to relatively high. The main structures of GI are river network (a large part of watercourses is regulated with a minimal presence of GI), uncultivated or extensively cultivated river floodplains, single-standing forest patches in elevations. The small elements of GI play an important role here: farmstead clusters (with greenery), tree rows and alleys, former manor parks, cemeteries, etc.			
Farmland-forest landscape	Large forest tracts with relatively large areas of agricultural lands (a large part of which is drained wetlands) in the wavy plain terrain. Forests often comprise large tracts of marshes and bogs. Two sub-types can be distinguished: forest-farmland landscape (dominated by forests) and farmland-forest landscapes those dominated by agricultural lands.	Wavy plain farmland-forest landscape	Skrīveri-Večbeķi rural landscape, Bērzaune-Atašiene rural landscape
		Wavy plain forest-farmland landscape	Ziemeļsusēja landscape
The GI spatial structure is formed mainly by forest tracts and wetlands, natural watercourses and water bodies play an important role. Greenery of farmsteads and rural settlements, small forest patches, as well as clusters of trees and shrubs on agricultural lands, parks and cemeteries also play an important role.			
Mosaic type landscape	Characterized by the mix of larger and smaller forest tracts and agricultural lands. Especially typical in hilly terrain, where the mosaic-type landscape is formed in relation to its natural conditions; but it is also found in undulating plain terrain, where this spatial structure has formed as a result of wetland reclamation and overgrowth of agricultural lands.	Mosaic type landscape in hilllands	Zebrus-Lielauce, Vietalva, Sēlija hilly landscapes
		Mosaic type landscape in wavy plains	Vecumnieki-Skaistkalne, Aknīste rural landscape
The matrix of GI here is the mosaic structure of the landscape itself - the mix of forests, agricultural lands, wetlands and waterbodies. Of particular importance in these areas are biologically valuable forest stands and perennial and semi-natural grasslands. Important role plays various historical elements of GI – cemeteries and manorial parks.			
Forest landscape	Continuous forest tracts with small clusters of agricultural land and settlements (particularly along rivers). Forest landscapes can be found both on flat plains and on undulating plains. Flat plain forest landscapes are relatively homogeneous, characterized by drained woodlands. In some places inland dune massifs can be found.	Lowland forest landscape	Tīreļu forest, Garoza forest, Misa forest landscapes
		Forest landscape in wavy plains	Taurkalne forest, Odze forest landscapes
In forest landscapes, which form the basis of GI matrix, some extensively managed patches of agricultural land, orchards and farmsteads are of particular value. Significant role has biologically valuable forest stands.			
Wetland landscape	Continuous bog and marsh areas, wet forest tracts.		Tīreļi wetland, Teiči wetland landscapes
The main structures of the GI are large bogs (excluding peat extraction sites) and non-ameliorated forest tracts. The rare patches of single farmsteads and extensively managed agricultural lands should be singled out.			
Landscape of ancient river	Sections of large river valley (together with the ancient river beds) with particularly rich		Daugava ancient valley landscape

valley	historical and cultural landscape elements.		
The main structures of GI are forest areas, natural water bodies, wetlands, extensively managed perennial grasslands and semi-natural meadows and pastures. Of particular value are cemeteries and former manor parks.			
Urbanised landscape	Landscape of densely populated areas. Depending on the population, historical development and current landscape development processes urban and suburban landscapes can be distinguished (typical urban expansion processes and merging with villages close to the towns), urban landscapes (urban environment in the town center), and village (rural urbanization, features of urban structure) landscapes.	Urban and suburban landscape	Dobele, Bauska, Jelgava, Aizkraukle, Jēkabpils urban and suburban landscapes, Kokneses landscape
		Urban landscape	Jaunjelgava, Pļaviņu urban landscape
		Village landscape	Auce, Viesīte, Aknīste town landscape, Iecava, Skrīveri village landscape
In the urban landscape, the main structures of GI are watercourses and water bodies and their semi-natural or extensively managed coastal zone, old parks. The city's forests, forest cemeteries, tree greeneries (around churches, castles), orchards and individual large trees play an important role. Particular attention should be paid to family garden areas, which can often contain a large variety of crop varieties (fruit trees and shrubs).			

Based on the regional assessment of ecosystem services (Chapter 5) and in particular the geospatial analysis of hotspots / cold points for environmental ecosystem services (Figure 6.1) as well as the qualitative GI analysis of ZPR landscape types, three stages of GI planning can be distinguished (Table 7.2); their territorial location is given in 8.2. in the picture.

Based on the assessment of the of ecosystem services at regional scale (Chapter 5), and the geospatial analysis of the provision of regulating ecosystem services (Figure 5.1), as well as the qualitative analysis of the landscape type, three levels of necessity of GI planning are identified (Table 7.2); their territorial location is provided in Figure 7.2.

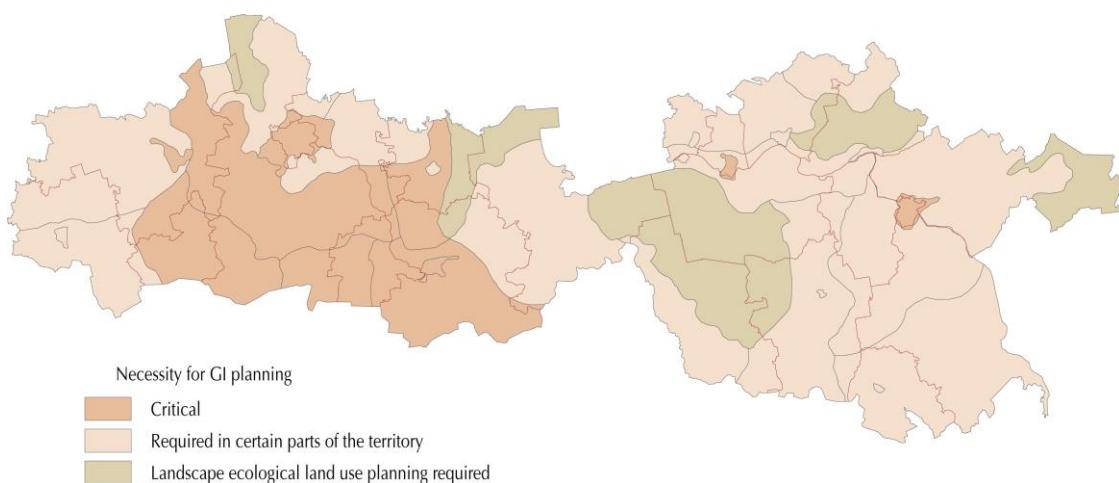


Figure 7.2. Necessity for GI planning in the Zemgale Planning Region.

Table 7.2. Necessity levels for GI planning

CRITICAL NEED FOR GI PLANNING	regulating services are not adequately provided throughout the area, the impact of their shortages extends beyond the area (region) borders; it is necessary to introduce a small GI elements (wetlands, buffer strips), and ensure GI connectivity.
GI PLANNING IS REQUIRED IN CERTAIN PARTS OF THE TERRITORY	regulating services are not sufficiently provided in certain parts of the territory, the impact of their shortages is attributable to local problems; it is necessary to introduce small GI elements (wetlands, buffer strips), ensure GI connectivity.
LAND USE ECOLOGICAL IS PLANNING REQUIRED	regulating services are provided at sufficient levels, but there is a need for regional ecological integrity (e.g. ecological planning of clear-cuts), integration of cultural services (mainly recreational) into the spatial structure of GI.

8 Description and assessment of green infrastructure in the Zemgale Plains landscape region

The European Commission states that green infrastructure (GI) is a “strategically planned network of natural and semi-natural areas designed to provide a wide range of ecosystem services, such as water purification, air quality, space for recreation and climate change mitigation and adaptation”. GI also plays an important role in preserving and improving biodiversity and in reducing the fragmentation of habitats.

The landscape region of Zemgale Plains has been selected as the area of deep-seated research – the area where the ES analysis identified the largest trade-offs between the provisioning and regulation ES, the statistical analysis of cold/hot spots showed the densest cold spots distribution within it (see Section 5). Intensive farming practices have significantly altered the natural conditions in the Plain, while the major consequences of intensive farming are water pollution and eutrophication, soil degradation, soil wind erosion and the decline of diversity as a result of insecticides.

Within the framework of research, were prioritised the areas that could potentially provide ES to mitigate the negative effects of intensive farming, with an emphasis on adaptation to climate change, both in order to reduce practices that increase GHG emissions (tillage of organic soils) and practices that reduce the consequences of extreme climate phenomena (intense flooding and flooding). In addition, the capacity of potential GI structures to provide certain provisioning and cultural ES has been taken into account, as well as the assessment of potential multi-functionality.

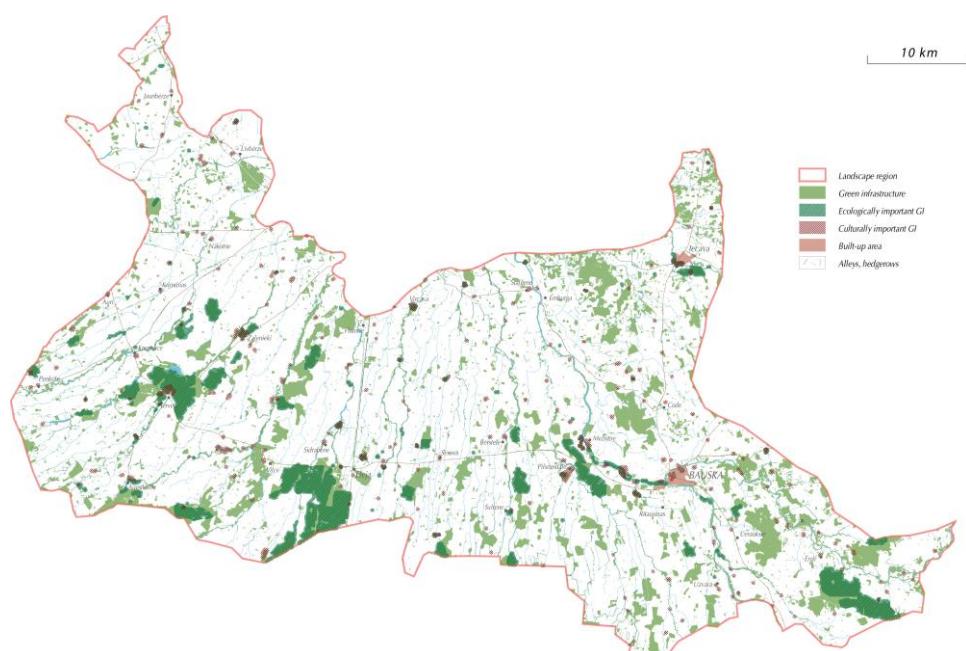


Figure 8.1. Green infrastructure of Zemgale planning region

Types of land cover/land use (LULC) that serve as a base GI (Figure 8.1) are natural/semi-natural uses of land (shrubland, wetland, unmanaged grasslands, forest, swamp) and other land uses that are not characterised by intensive intervention in the surface of the soil (permanent grassland, orchard and park), which are potentially capable of providing the ES by minimizing the negative impacts of intensive agricultural practices. The division of LULC within the scope of potential GI and their relevance to landscape quality objectives is shown in Table 8.1.

Table 8.1. LULC within potential GI and its connection to landscape quality objectives

LULC	Area (km ²)	Proportion (%)	Landscape quality objectives
Forest	345,30	82,6	water pollution reduction, landscape diversity, aesthetics, recreation, biodiversity
Shrubland	4,18	1,0	water pollution reduction, landscape diversity, recreation, biodiversity
Permanent grassland (managed)	24,91	6,0	water pollution reduction, landscape diversity, aesthetics, recreation, multi-functionality, biodiversity
Grassland (unmanaged)	17,53	4,2	water pollution reduction, landscape diversity, biodiversity
Park	1,94	0,5	diversity of the landscape, aesthetics, recreation, cultural history, biodiversity
Wetland	0,89	0,2	diversity of the landscape, aesthetics, recreation, cultural history, biodiversity
Peatbog	0,29	<0,1	water pollution reduction, landscape diversity, biodiversity
Orchard	22,34	5,4	water pollution reduction, landscape diversity, aesthetics, multi-functionality

The LULC potentially linked to GI accounts for 17% of the Zemgale Planning Region and is attributable to the large forest areas, the unregulated river valleys, small clusters of forests, and the patches of small landscape elements (homesteads, manors and churches, patches of bushes and rows of trees).

To establish connection between GI and ecologically important areas (protected areas, semi-natural grasslands) an ecologically relevant data set has been created. A historical data set has been established to assess potential links of GI to historic sites (cultural monuments and their protection zones). The functionality of GI was assessed by calculating multiplicity of provided ES (Table 8.2).

Table 8.2. Multi-functionality of GI.

	Ecosystem services								
Land use	Chemical conditions of freshwaters	Soil surface erosion	Global climate control	Habitat maintenance	Pollination and seed dispersal	Medical herbs	Game animals	Recreation	Aesthetics
Permanent grassland	x	x	x	x	x	x	x	x	x
Shrubland	x	x	x	x			x		
Wetland	x	x	x	x	x		x		
Forest	x	x	x	x	x	x	x	x	
Park	x	x		x	x	x		x	x
Peatbog	x	x	x	x	x	x	x		x
Orchard	x	x			x				x
Unmanaged grassland	x	x	x	x	x	x	x		
	Targeted regulating ES		Another regulating ES		Provisioning ES not connected with intensive agriculture		Cultural ES		

9 Green infrastructure development scenarios in the Zemgale Plains landscape region

GI scenarios were assessed in two types of spatial sections of rivers, which form the basis for further development scenarios:

- within 30 m of the buffer zone – 30 meters from the riverbanks in both directions, the optimum distance required to detain dissolved nutrients and soil particles;
- within 100 m of the buffer zone - within 100 meters of the riverbanks in both directions coinciding with the river protection zone.

The 30-meter buffer zone is potentially capable of providing the necessary regulatory ES, but due to the relatively small size of the area, provision of agricultural services related to agricultural production may prove difficult. There is a serious risk that the GI located in the buffer zone may lose its multi-functionality and would be managed solely for the purpose of providing the regulatory ES, and thus its maintenance costs may be disproportionately high. On the other hand, the installation of the GI in 100 m buffer zones would not only provide opportunities to supply regulatory ES and mitigate the negative environmental impact of industrial agriculture, but also to facilitate the diversification of agricultural production. Non-intensive farming practices contribute to biodiversity, scenic aesthetics and recreational value, thus also opening up the potential for business diversification and land management sustainability. Such size buffer zones potentially can be used as ecological network corridors

Scenarios were developed using the Viva Grass integrated planning tool, which allows prioritization of land use changes based on their potential to provide selected ES in given agro-ecological conditions and geographic location. The basic data in the tool (declared agricultural land use data, terrain surface model and digital soil map) were supplemented with drainage data base, which includes information on watercourse regulation intensity, and data on flood risk areas. Land use type was chosen as the dependent variable for the development of the integrated planning tool algorithm, as the independent variables were chosen location in the flood risk zone, soil composition and intensity of water flow regulation. The scenarios were developed for two spatial divisions - 100 m buffer zone and 30 m buffer zone. Separate ecosystem services with expert weighted factors were selected as additional weights in the priority. As a result of the calculations, 5 possible priorities were developed for land use change in 100 m and 30 m buffer zones (Table 9.1).

Table 9.1. Priorities of land use change in selected buffers

Priority	Dependent variables	Independent variables
Highest	Arable land, cultivated grasslands	Regulated watercourse, organic soil, flood risk area
High	Arable land, cultivated grasslands	Regulated, semi-regulated, unregulated watercourse, outside flood risk area, on organic soils
		Regulated, semi-regulated, unregulated watercourse, flood risk zone, on mineral soils
Medium	Arable land, cultivated grasslands	Regulated, semi-regulated, outside the flood risk area, on mineral soils
Low	Arable land, cultivated grasslands	Non-regulated watercourse, outside the flood risk area, on mineral soils
None	Permanent grasslands, semi-natural grasslands	Regulated, semi-regulated, unregulated watercourse, both within and outside the flood risk area, on organic soils

Based on the developed priorities, 3 scenarios have been developed for decision makers:

- "absolute minimum" - change of land use to permanent grasslands in the areas of highest and high priority;
- "minimum" - change of land use to permanent grasslands in the areas of highest, high and medium priority;
- "maximum" – change of land use to permanent grasslands in the highest, high, medium and low priority areas.

Table 9.2. Areas of agricultural land to be transformed with the implementation of GI scenarios.

Scenario	Area of proposed transformation (ha)	
	30 m buffer	100 m buffer
absolute minimum	35,4	142,2
minimum	181,1	693,9 (0,3%)
maximum	5489,3 (3%)	21477,8 (12%)

Table 9.2 shows the required amount of agricultural land transformation in each scenario. Under the 'absolute minimum' scenario, the transformation of agricultural land would be carried out in very small areas and will not have a significant impact on the agricultural production of the region. Implementation of the "minimum" scenario would require in-depth study of the farms affected by land use transformation and an individual approach to each property, while avoiding shifting the economic burden of transformation to the farmer. In this scenario, the area of agricultural land to be transformed is as well too small to form a special agri-environment measures, as it would be required under the "maximum" scenario.

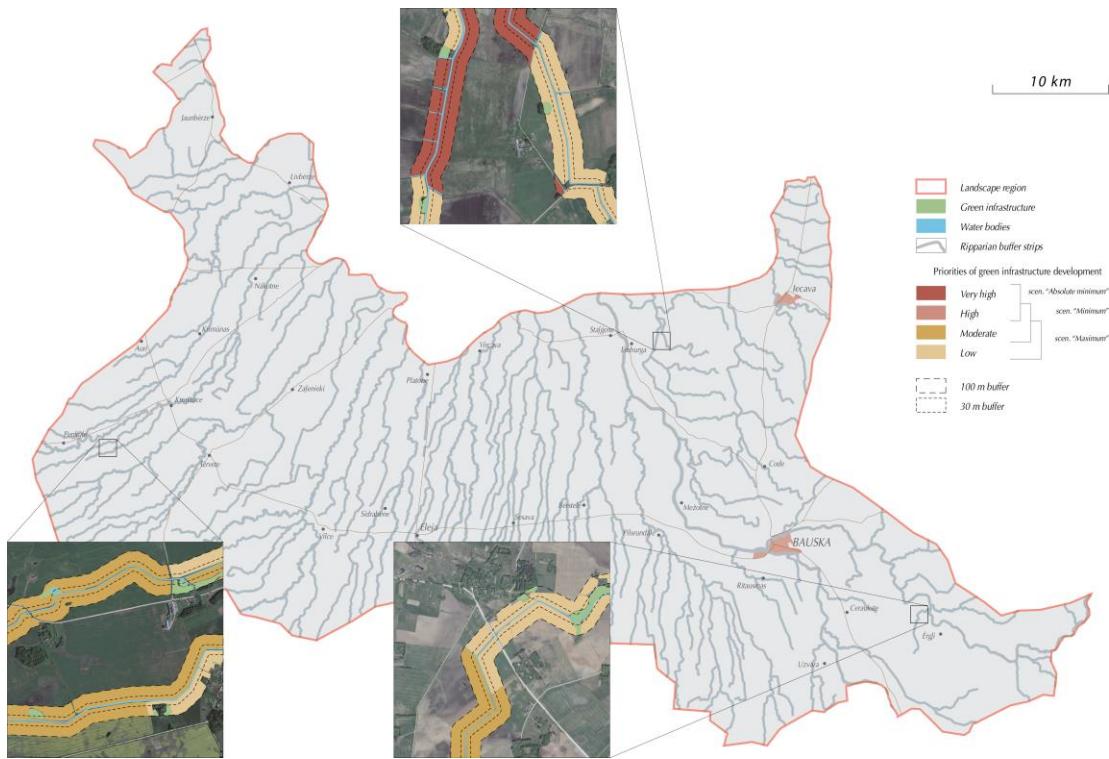


Figure 9.1. Green infrastructure development scenarios in the Zemgale Plains landscape region.

10 Landscape quality objectives

Landscape assessment of ZPR thematic plan is based on landscape quality assessment and spatial analysis (Table 10.1)

Table 10.1 Landscape qualities and indicators

Landscape qualities	Indicators
Landscape diversity	<i>Land use diversity</i> <i>Lake density</i> <i>River density</i> <i>Landscape small elements</i> <i>Settlement density</i> <i>Field size</i> ...
Historicity	<i>Presence of historical landscape structures</i> <i>Historical landmarks</i> ...
Cultural heritage	<i>Density of historical monuments</i> <i>Diversity of cultural monument types</i> <i>Management of cultural heritage</i> <i>Accessibility of cultural heritage</i> ...
Recreation	<i>Distribution and density of tourism objects</i> <i>Proportion of nature parks, national parks, nature monuments</i> <i>Diversity of tourism and recreational infrastructure</i> <i>Bicycle routes</i> <i>Swimming, boating possibilities</i> <i>State forests for recreation</i> <i>Accessibility of accommodation</i> ...
Scenic and aesthetic	<i>Scenic landscapes</i> <i>Visual pollution and abandoned elements</i> <i>Scenic road landscapes</i> ...
Naturalness	<i>Naturalness of watercourses</i> <i>Biologically valuable grasslands</i> <i>Proportion of SPNA</i> <i>Proportion of natural land cover</i> <i>Proportion of microreserves</i> <i>Proportion and distribution of ameliorated areas</i> ...
Spiritual	<i>Density of sacred places</i> <i>Density of churches</i> <i>Density of cemeteries</i> ...
Uniqueness	<i>Significant landscapes and places at national level</i> <i>Protected landscapes at national level</i> <i>Significant landscapes and places at regional and local level</i> ...

The general landscape quality objectives (LQO) identified in the thematic plan are directly linked to the assessed landscape quality (characteristics) and the assessment of the GI (see sections 8 and 9). All LQO are directly or indirectly linked to green infrastructure: the most direct link is expressed in the landscape diversity, landscape naturalness and recreational qualities of the landscape (Figure 10.1).

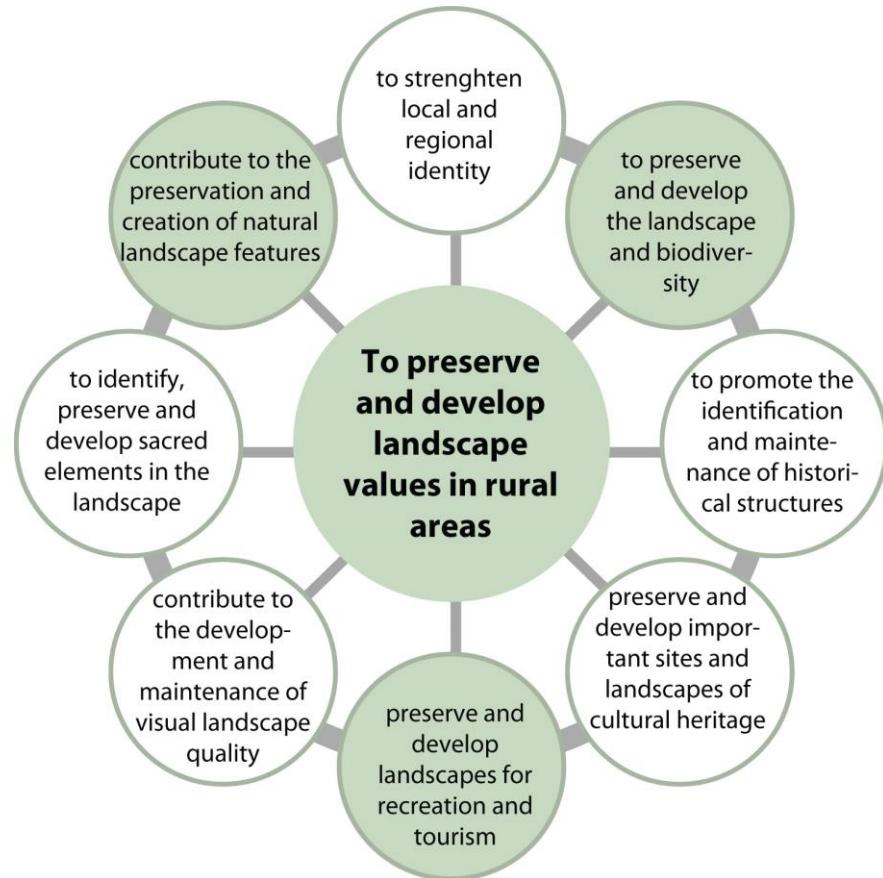
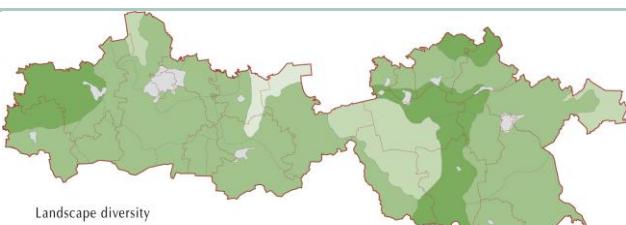
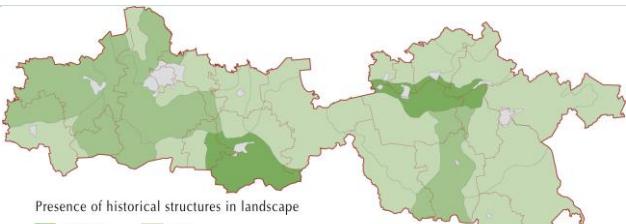
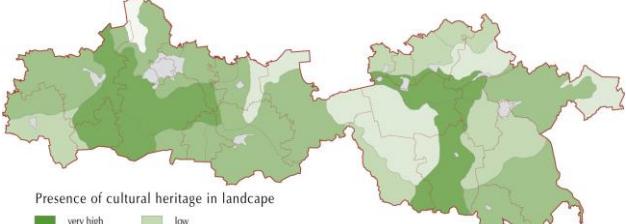
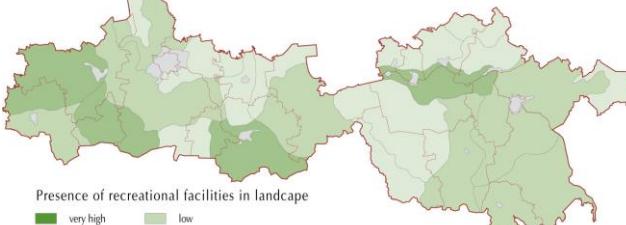


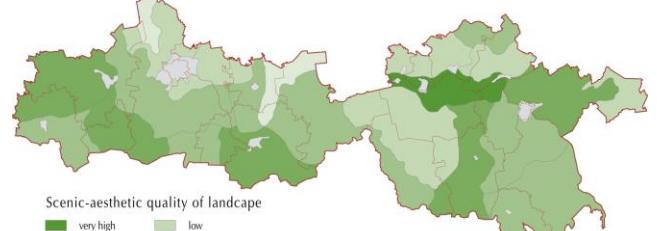
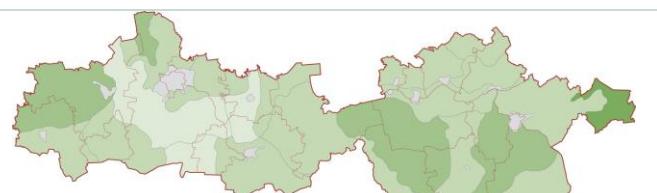
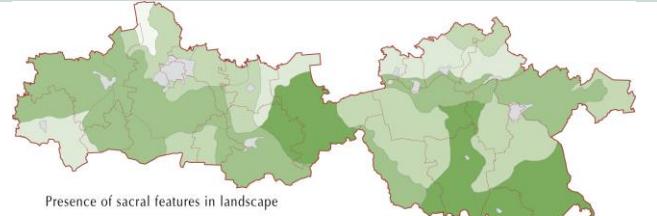
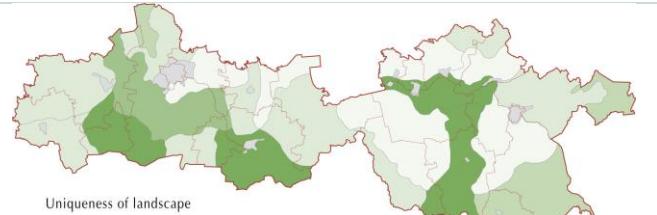
Figure 10.1. Landscape quality objectives in the Zemgale Planning Region.

10.1 Landscape qualities in ZPR's landscape sub-regions

The plan provides a general assessment of the quality of the landscape of ZPR and an interpretation of their spatial structure. Table 11.2 contains maps, which describe the assessment of the landscape quality indicators and their spatial distribution, as well as a general outline of the landscape quality objectives.

Table 10.2. Landscape qualities in ZPR's landscape sub-regions and general LQO

Landscape qualities in landscape sub-regions	General LQO
 <p>Landscape diversity</p> <ul style="list-style-type: none"> very high high moderate low very low settlement landscape 	<p>The development of landscape diversity as landscape quality is essential in relatively homogeneous landscapes, where human economic activity has simplified a landscape structures (e.g. in agro-landscapes or forest landscapes). Small landscape elements (such as alleys, tree rows and buildings) should be promoted in the agro-landscapes, assessing their ecological, visual and cultural importance.</p>
 <p>Presence of historical structures in landscape</p> <ul style="list-style-type: none"> very high high moderate low very low settlement landscape 	<p>The assessment of landscape historicity is essential for the identification and assessment of sites of historical importance in the local landscape. Currently, there are no such assessments in county-wide landscape plans, or they are inconsistently carried out and not comparable to each other.</p>
 <p>Presence of cultural heritage in landscape</p> <ul style="list-style-type: none"> very high high moderate low very low none settlement landscape 	<p>It is important for municipalities to recreate local cultural monument landscape sites where the monument is managed in the context of the surrounding landscape. Achieving the LQO requires the development of individual protection zones for each cultural monument and linking them to the designation and development of cultural historic sites.</p>
 <p>Presence of recreational facilities in landscape</p> <ul style="list-style-type: none"> very high high moderate low very low settlement landscape 	<p>Actions should be linked to the identification of the recreational and tourism potential of the landscape, both locally and regionally, and the development of a diversity of recreational infrastructure in cooperation with local authorities, entrepreneurs and inhabitants.</p>
RECREATION <p>LQO – to identify, create and develop the recreational potential of the landscape.</p>	

 <p>Scenic-aesthetic quality of landscape</p> <ul style="list-style-type: none"> very high high moderate low very low <p>settlement landscape</p>	<p>The actions to reach objectives are to identify and assess scenic landscapes views and routes on a local scale, develop viewing platforms and promote accessibility to view landscapes, along with the creation and development of recreational infrastructure, and to evaluate the necessary landscape maintenance measures for opening views.</p>
<h3>SCENIC VALUE</h3> <p>LQO – to promote the development and maintenance of scenic landscape qualities.</p>  <p>Naturalness of landscape</p> <ul style="list-style-type: none"> very high high moderate low very low <p>settlement landscape</p>	<p>Actions to achieve this LQO are linked to targeted GI planning, which would contribute to the enhancement of different ecosystem services, as well as the identification and development of different valuable habitats. Stimulating the diverse agri-environmental measures is essential for agro-landscapes.</p>
<h3>NATURALNESS</h3> <p>LQO – to promote the development and maintenance of natural landscape qualities.</p>  <p>Presence of sacral features in landscape</p> <ul style="list-style-type: none"> very high high moderate low very low none <p>settlement landscape</p>	<p>Identify and maintain the sacred heritage of the municipalities by creating them as important cultural and historical, visual (as anchors) and social elements of the landscape.</p>
<h3>SACREDNESS</h3> <p>LQO – to identify, preserve and develop sacred elements of the landscape.</p>  <p>Uniqueness of landscape</p> <ul style="list-style-type: none"> very high high moderate low very low unknown <p>settlement landscape</p>	<p>Actions at local and regional level can be linked to the systematic identification and image-building of highly valued landscapes both municipal and regional; the identification of unique sites and the allocation of symbolic values at regional and local level, thus strengthening and promoting the recognition of landscapes and sites at national level.</p>
<h3>UNIQUENESS</h3> <p>LQO – to strengthen the place and regional identity.</p>	

10.2 Landscape quality objectives in the Zemgale Plains landscape region

A more detailed assessment of the landscape qualities and actions for achieving the LQO of action is provided for the Zemgale Plains landscape region (ZPLR). The assessments of the quality indicators of ZPLR are summarised and presented in Table 10.3, place-based actions to achieve these objectives are summarised in Table 10.4.

Table 10.3. Landscape qualities and indicators in the Zemgale Plains landscape region.

Landscape quality (indicator sum-value ¹)	Indicators (evaluation scale 0-5) ²						
Diversity 3	Land use diversity 2	Density of water bodies 0	Density of rivers 4	Density of small landscape elements 3	Settlement density 5		
Historicity 3	Presence of historical landscape structures 2	Historical landmarks 3					
Cultural heritage 4	Density of historical monuments 3	Diversity of historical monuments 4					
Recreation 1	Distribution and density of tourism objects 2	Proportion of nature protection areas for recreation 1	Proportion and density of recreational elements 2	Diversity of recreational elements 1	Bicycle routes 1	Density of natural swimming sites 1	Forests for recreation (State forestry) 1
Scenic 3	Scenic views 3	Scenic routes 3					
Naturalness 2	Naturalness of streams 3	High nature value farmland 1	Proportion of specially protected areas 1	Proportion of natural land cover 2	Proportion of micro-reserves 1	Proportion and distribution of ameliorated areas 1	
Sacredness 3	Density of sacred (cult) sites 2	Density of churches 2	Density of cemeteries 3				
Uniqueness 3	Landscapes of national and regional values 4	Protected landscapes in specially protected areas 1					

¹ Weighted sum method and expert judgment.

² Weighted sum method and expert judgment.

Values of landscape quality indicators	No such quality provided 0	Very low value 1	Low value 2	Moderate value 3	High values 4	Very high values 5
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Table 10.4 Recommendations for actions to achieve landscape quality objectives in Zemgale plains landscape region.

Landscape qualities	Recommendations for actions to achieve landscape quality objectives
DIVERSITY	<ul style="list-style-type: none"> - encourage the maintenance and development of green infrastructure (GI) mainly in river valleys (see scenarios for GI development); - promote creation of small landscape elements, preserve and create alleys, hedgerows and orchards; - promote diversification of agricultural production, encourage non-intensive farming techniques, preferably connected with permanent grasslands in close proximity of rivers especially on organic soils; - create narrow grassland or temporarily non-managed land field strips; - diversify crop cultures thus ensuring asynchronous management of adjacent fields; - restore wetlands in flood risk territories, especially on organic soils.
HISTORICITY	<ul style="list-style-type: none"> - identify historical landscape values within the municipality such as local scale thematic planning or the ZPR study order. Attention should be paid to the old woodlands, the types of historical settlements (manor centres, old farms, villages), the old roads (including bridges); - organise a variety of events that encourage public participation in the identification of historical elements.
CULTURAL HERITAGE	<ul style="list-style-type: none"> - encourage the development of individual protection zones for cultural heritage monuments on a local scale (partly addressing accessibility and visual landscape quality issues), regard monuments as potential landscape anchors; - develop studies on the state of monuments and potential applications in the area of site development; - to perform a study on the cultural and historical heritage at landscape scale.
RECREATION	<ul style="list-style-type: none"> - establish a systematically organised tourism and recreation database, as well as clarifying inhabitant views (e.g. surveys and focus group interviews) on their expectations regarding recreational needs; - develop a study on recreational and tourism facilities along rivers and rivers for different social groups, as well as the accessibility of major rivers, thereby strengthening the identity of the region; - encourage the establishment of bicycle routes, particularly Eleja-Svitene, Iecava-Code and Tervete-Augstkalne; - create physical recreational paths (running, walking) along rivers, promote the setting up of hiking routes.
SCENIC VALUE	<ul style="list-style-type: none"> - promote creation of viewing towers for landscape observation (supplemented with informational stands about value of landscape

	<p>elements and their historical formation);</p> <ul style="list-style-type: none"> - encourage the development of viewing platforms on the shores of large river valleys; - promote measures to identify the scenic values of the landscape in Zemgale Plains.
NATURALNESS	<ul style="list-style-type: none"> - promote implementation of GI scenarios by establishing river protection zones; - promote the development of wetlands in high flood risk; - create permanent grasslands in close proximity to the rivers, plan the existing spatial connectivity of biologically valuable grasslands, particularly within the framework of the ecological network; - plan the connectivity of protected areas within the framework of the ecological network; - promote the installation of environmentally friendly drainage systems in potentially beneficial/environmentally relevant places; - encourage the restoration of the hydrological regime in economically disadvantaged areas (polders, wetlands, organic soils).
SACREDNESS	<ul style="list-style-type: none"> - build a database on sacred landscape elements, thereby enriching information on cultural and historical landscape; - support studies for local research of sacred elements; - promoting the collection of local communities' experience and stories in relation to the different elements of the landscape.
UNIQUENESS	<ul style="list-style-type: none"> - encourage a study on landscape values of Zemgale Plains (including historical landscape structures) on a local scale aimed to identify local cultural historical landscapes; - identify and systemise various representations of landscapes of Zemgale Plains – cinema, literature, art; - update and systematise products and services related to the Zemgale Plains, thereby creating links between these products and services and a specific landscape thus strengthening the identity of sites and landscapes.

11 Recommendations for landscape and green infrastructure governance in the Zemgale Planning Region

Landscape management should ensure the achievement of the LQO by coordinating processes between different levels of governance, sectors and actors. The recommendations for landscape and GI management in ZPR to achieve these objectives are:

I – build a new territorial management unit “regional parks” (or “regional nature and cultural parks”, regional landscape parks) under the administrative responsibility of the planning region, these units would include particularly valuable landscapes and/or landscapes of the region, which require additional incentives (Figure 11.1).

The main role of these parks would be to promote the development and sustainable value of the landscape by supporting their natural and cultural and historical resources, including balancing natural values (GI) with rural development. Such parks would act as a platform for promoting interlinked landscape quality and the LQO, promoting the development of a multi-functionality of GI, the development of recreation and tourism, the promotion of local brands, cultural history, rural life, etc.

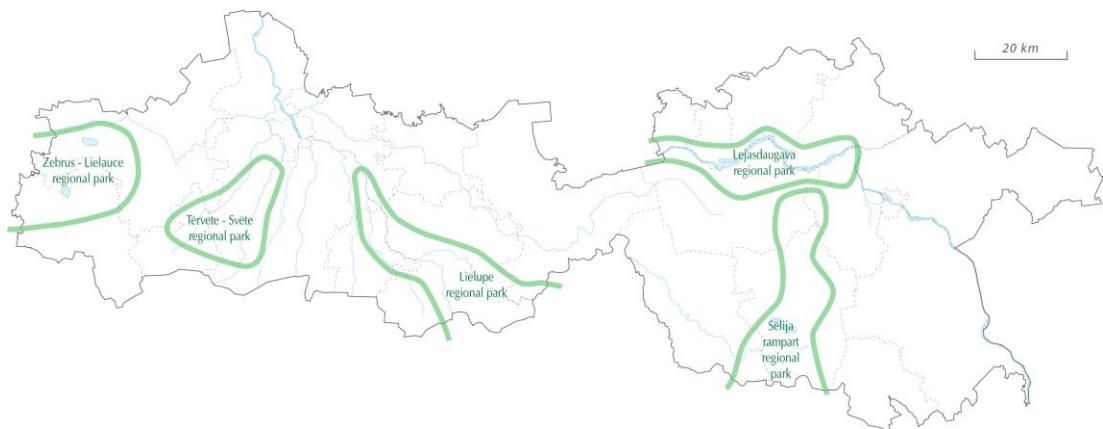


Figure 11.1. Proposition for regional park development.

II – develop and coordinate a landscape change monitoring system based on analysis of ZPR historical landscape change, the drivers of modern change and the modelling of landscape scenarios.

III – build a database, promoting and coordinating research and publishing of informative materials on green infrastructure and the provision of ecosystem services, as well as climate mitigation and adaptation projects in ZPR.

Landscape management is a multi-level, multi-sectoral and multi-stakeholder entity and therefore requires strategies and mechanisms for harmonising rules and coordinating decision-making processes between these different levels, sectors and actors. Landscape management can be defined as a set of rules (policy and cultural norms) and a decision-making process involving public, private and civil actors with different capabilities and needs to influence landscape activities.

Cross-border management approach and building platform for communication

One of the main points in the specific nature of regional landscape planning is the need for management and planning beyond the boundaries of formal administrative units (**cross-border management approach**), since the boundaries of landscape and landscape spaces do not largely coincide with the administrative borders of municipalities (Figure 11.2). Only through cross-border landscape planning and management can it be ensured that landscape quality objectives are fully and efficiently achieved. The effective functioning of landscape management in the planning region should mean at least one **responsible specialist** coordinating the overall process of achieving the LQO within the framework of the regional landscape thematic plan, the development of thematic plans for the planning region's municipalities (landscape assessments) and the action plans for the achievement of the LQO.

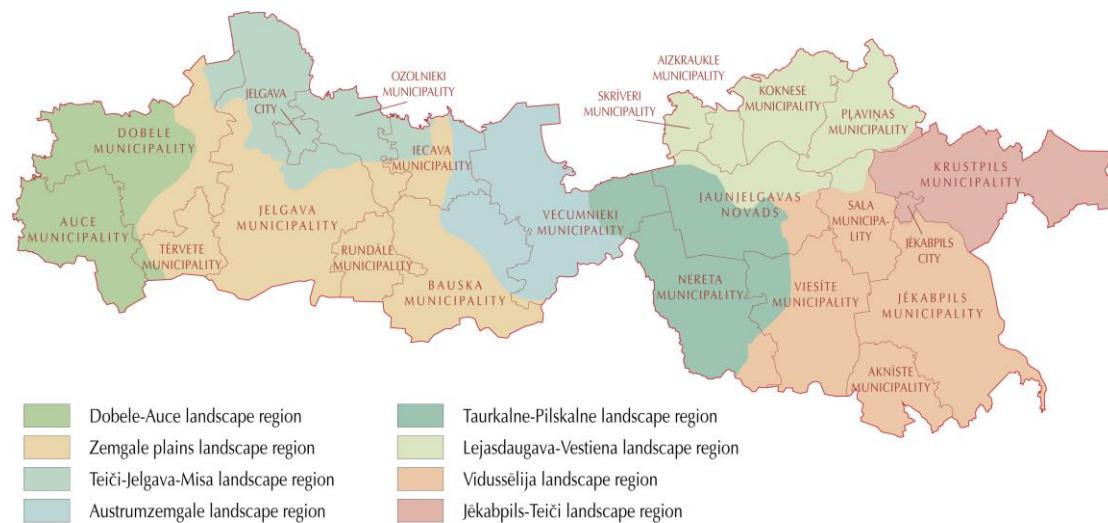


Figure 11.2. Landscape regions and municipality borders in Zemgale planning region.

In order to implement a cross-border management approach and efficient landscape planning across the region, a **landscape planning and management hierarchy** should be developed:

- a thematic landscape plan should be developed at the **level of the planning region** (the basic planning unit of which is landscape region and landscape sub-regions forming it) by developing cross-border cooperation with neighboring planning regions. The landscape thematic plan should identify the general LQO, identify recommendations for action to reach the LQO within the regional framework and identify specific landscape spaces at regional level.

- **the governance level of landscape regions** should serve as a communicative platform, which harmonises the interests of landscape planning and management between the planning region (regional/national interests) and local authorities (local interests), both within the region's special landscape areas and landscape sub-regions;
- thematic plans for landscape should be developed at **municipal level** following a common approach (guidelines) and taking into account the thematic plan of the planning region.