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LANDSCAPE SENSITIVITY ASSESSMENT WITHIN SPATIAL DEVELOPMENT SCENARIOS. LATVIA CASE STUDY

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Abstract. Abstract. European countries have different experience in landscape characterisation and assessment. Comparing the different approaches used in different European countries, it is proposed to use the method developed and validated in the United Kingdom - Landscape Character Assessment, adapted and modified for the Latvian situation. This approach has also been used in most other European countries, which have chosen to use the UK approach to landscape characterisation, adapting it to their specific national situation. The need for a landscape assessment in Latvia is highlighted in the Latvian Landscape Policy Guidelines 2013-2019 and Latvian Landscape Policy Implementation Plan 2024-2027, taking into account the actions set out in the European Landscape Convention to be taken by all Parties to the Convention. The purpose of the research was to carry out the analysis of Latvian landscape sensitivity within spatial planning scenarios important for local municipalities. It is of high importance to assess landscape sensitivity for changes of build and natural environment influencing pace and scale of development of the rural areas of Latvia. As local municipalities set different goals for their spatial development, common spatial development scenarios were chosen to make analysis of landscape sensitivity in Latvian landscapes. Results from the analysis of landscape sensitivity show variation of suitable actions to be implemented if different places in Latvia. The results also can be used for defining landscape quality goals to harmonise scope of activities to be implemented by local municipalities of Latvia.

Keywords: landscape assessment, landscape sensitivity, landscape capacity, European Landscape Convention

Introduction

Considering the multidisciplinary nature of landscape, there are different approaches and methods used in landscape research in different disciplines (geography, geology, geomorphology, ecology, history, archaeology, landscape architecture, etc.), based on the traditions and experience of the specific disciplines [2; 9; 13; 21; 23]. Within the framework of these different sectors, the concept of landscape emphasises different qualities or characteristics, and consequently landscape studies use only discipline-specific approaches and criteria [5; 6; 21; 23; 26].

Historically, two distinct blocks of landscape research have emerged. One is based on the appreciation of landscape character as reflected in the arts and humanities (painting, literature, etc.), the other on the biophysical properties of landscape, which are emphasized in the natural sciences, and also the use of land resources [5; 21; 23]. The priority given to the use of land resources also meant that, until the 1970s, landscape assessment was based on economic objectives, aiming to increase productivity and make the most efficient use of resources, which clearly led to the intensification of land use [25; 27]. At that time, the negative impact of this one-sided use of large areas, and hence of landscapes, on ecosystem functioning and the rural environment was not addressed.

Following the adoption of major environmental legislation [3] in the 1960s and 1970s, the development of ecological assessment methodologies was encouraged. This made it possible to assess the structure, function and potential of a site in relation to the natural equilibrium capacity of the landscape. As these theories developed, the fact remained that landscape assessment always involves anthropogenic interference with the natural balance [23; 25; 27]. This interaction between nature and man makes it necessary to value ecosystems that are otherwise virtually value-free, since valuations are to a certain extent the result of certain social settings and are therefore subject to change.

The adoption of the European Landscape Convention [12] in 2000 included a much broader understanding of landscape, going beyond the physiographic characteristics of landscape to include cultural, historical, social and economic aspects, everyone's right to landscape and the transmission of landscape values to future generations, as well as educational issues. The lessons of the European Landscape Convention are therefore geared towards action and the implementation of a comprehensive and integrated landscape policy through mutual cooperation between the different sectors involved at all levels of landscape planning and management.

Latvia's landscapes, natural and cultural resources are constantly changing in response to the direct and indirect impacts of human activities and natural processes, leaving a historical record in particular places. Over time, changes in agriculture, industry, society and the environment have had a significant impact on the intensity of landscape change. In many cases, change has been rapid, driven by changes in political or administrative regimes, land ownership patterns or population fluctuations. The result of these changes and the breadth of their impact is particularly evident at the larger scale of the rural landscape [4; 5; 6; 13]. For example, the wide range of infrastructure improvements that have taken place over different periods, including rural electrification and road improvements, have contributed to changes in the Latvian countryside, in places expanding rural settlements. In many parts of rural Latvia, EU-supported investments in the agricultural sector have changed the scale and management approach of farming, contributing to farm income sufficiency and the sustainability of the agricultural sector [27].

The ability of each spatial unit of the landscape to absorb new development pressures will depend to a large extent on its sensitivity, and it is therefore necessary to assess the impact of different options on the landscape (Fig.1) [17; 18]. Landscapes are not only variable because of their different perceptions or scales, they are constantly being affected by various biological and social processes, such as urban and village sprawl or uncontrolled construction, transport and energy

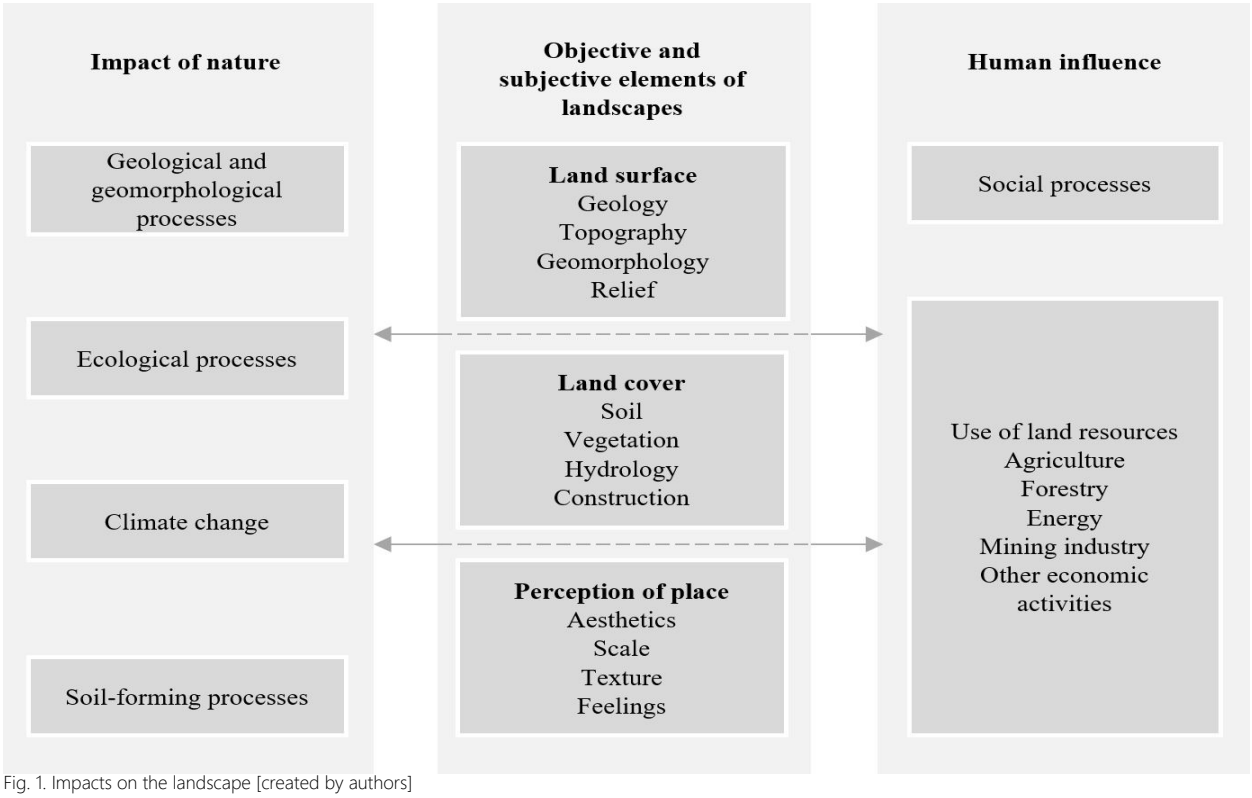

Fig. 1. Impacts on the landscape [created by authors]

infrastructure development, waste management and habitat loss, climate change and pollution, agricultural intensification or other changes in land use. It is therefore important to bear in mind the significance, nature and context of the impacts of development in order to ensure landscape quality while allowing development to take place [9; 15; 16; 22; 24; 25].

In a process of continuous change, the landscape continues to be transformed by different and changing patterns of land use and transformation, infrastructure and management. The consequences and significance of these changes cannot always be immediately assessed. People's perceptions change over time and new features can become valuable elements of the landscape [5; 7; 8; 11]. Development which will have a significant environmental and particularly visual impact will be best absorbed in spatial units where the landscape is resilient and able to absorb the pressures of development solutions. All developments and impacts should be assessed on a site-by-site basis in order to avoid, prevent or minimize potential adverse environmental effects. However, it is essential that change is managed in such a way as to maintain or enhance the qualities that make the Latvian landscape special and to preserve the diversity of its historical, cultural and ecological resources.

Methods

The Landscape Character Assessment (LCA) approach [17; 18], developed in England and Scotland in 2002, provided the basis for a comprehensive, integrated and action-oriented methodological approach to landscape assessment. Landscape Character Assessment (LCA) is a tool that integrates natural and cultural landscapes and human perception, describing the spatial framework for the implementation of the European Landscape Convention (ELC). Landscape character is defined as "a discrete, repeatable and consistent pattern of elements in a landscape that makes one landscape different from another, rather than better or worse" [12].

In order to carry out the Latvian landscape assessment, the Kamils Ramans' classification [19; 20] based on large-scale landforms dividing Latvian landscape spatial units into 16 landscapes (ainavzeme) was used, where relief is the main criterion for defining them. However, other criteria such as river basin boundaries, cultural and historical criteria, geographical location also play a role. The 89 landscape areas (ainavapvidi), on the other hand, also include as an important criterion the land cover represented in the name, which is a synthesis of relief and land use, supplemented by the names of places or objects in the area, which create a landscape perception that recognises the area [15; 16; 20].

The mapping of the rural landscape into 406 landscape character areas (ainavu areāli) areas has been developed within the LandLat4Pol project, initially defining the preliminary boundaries of the areas taking into account the land cover and the landscape structure it creates (e.g. areas with a mosaic of different densities of forest and open areas), topography, water structures and built-up areas. The boundaries of the landscape areas were later refined following field surveys, considering human perception in addition.

Using current spatial data, the LandLat4Pol project has refined and adjusted the boundaries of two upper levels of landscape division (Fig.2) based on cartographic maps of relief, topography, geomorphology, catchments, soils, as well as taking into account the boundaries of the lower spatial landscape units - landscape character areas - which have been refined after field surveys.

The capacity of each spatial unit of the landscape to absorb new development pressures will depend to a large extent on its sensitivity and therefore the impact of different options/scenarios on the landscape needs to be assessed (Fig.3).

The context in which a landscape is assessed will always be important. Depending on the objective of the landscape assessment, the tasks to be carried out and the scope of the work will vary. In addition to landscape characterisation based on data analysis and field surveys, it is recommended that landscape assessment includes an assessment of landscape impacts, landscape functions and values, highlighting existing and changing landscape structures and elements.

One of the most common purposes of landscape assessment

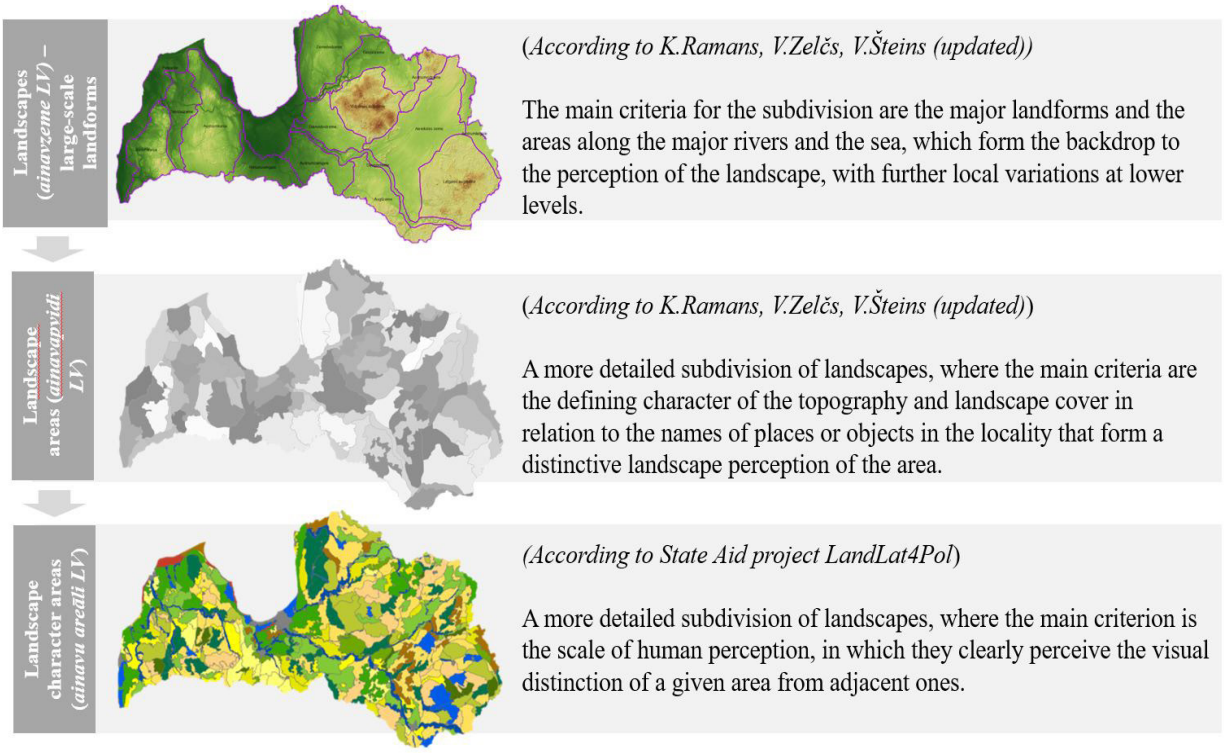

Fig. 2. Landscape division at different levels [created by authors]

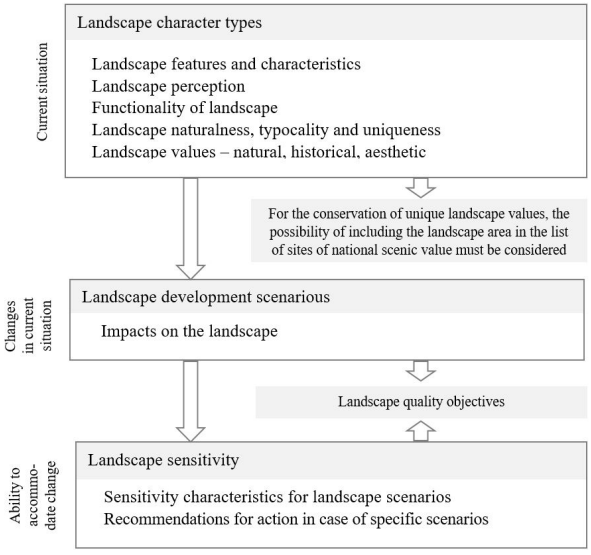

Fig. 3. Landscape sensitivity assessment process [created by authors]

is to determine the sensitivity or resilience of the landscape to environmental change as a result of various pressures. Landscape assessment leads to the preliminary setting of potential landscape quality objectives, which describe the condition to which the future landscape should aspire when planning and implementing different activities in a given area.

In order to ensure the quality of the landscape while allowing development to take place, it is important to bear in mind the significance, nature and context of the impacts of development. Landscape sensitivity thresholds can be used to describe the potential of a landscape as well as its sensitivity to change [18]:

- High sensitivity - Key landscape features and valuable qualities are highly sensitive to change due to changes in the type (area) and scale of development included in the assessment. They are unable to adapt to the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of the landscape planning policy and strategy.
- Medium sensitivity - Key landscape features and valuable qualities are moderately sensitive to change (with the potential to be resistant to change) from changes in the type (area) and scale of development included in the assessment. They have some capacity to adapt to the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policy and strategy.
- Low sensitivity - The key landscape features and valuable qualities have a low sensitivity to change due to changes in the type (area) and scale of development included in the assessment. Planned changes can be accommodated without significant change in landscape quality. They have the capacity to adapt to the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policy and strategy.
- The rating scale has intermediate values for the classification of landscape sensitivity, where for medium - high landscape sensitivity the proposed changes can be accepted minimally and only in some places, while for low - medium landscape sensitivity the proposed changes can be accepted to a reasonable extent in many places without significant change to landscape quality.
- Groups of landscape character and visual quality criteria can be used to determine the landscape sensitivity (at a pre-defined scale mentioned before) of a particular site [17; 18], where landscape character is defined by:
- Physical condition of the landscape - Landform, relief (predominantly flat, gently undulating or hilly terrain); Land cover, vegetation (predominantly cultivated fields, mix of rural woodland forming a mosaic or forest, woodland); Quality of agricultural land (assessment of the fertility of agricultural land); Proportion of protected areas (nature reserves, national parks, nature reserves) (these are small in area, uneven in distribution or dominated

by protected areas and form an important part of the identity of the area); Presence of water bodies (density of water bodies); Presence of watercourses (density of river network); Drainage systems (density of drainage systems in the area).

- Cultural/Social status - Land use (predominantly agricultural production or interspersed with forestry, or predominantly forestry); Cultural heritage (density and dispersion of cultural monuments in the area); Variety of cultural monuments (variety of types and types of cultural monuments in the area); Settlement structure (the territory is not settled, there are some settlements (homesteads) and the settlement is unevenly distributed in the territory or there are several concentrations of settlements (villages, towns) and the settlement is relatively evenly distributed, historical built characteristics); Location and density of tourist facilities (density and concentration of tourist facilities in different locations); Recreational facilities (diversity of tourist infrastructure); Cycling routes (presence of cycling routes in the territory).
- Aesthetic attractiveness - Naturalness (the landscape is based on natural and little modified landscapes, the natural areas are homogeneous in structure, without pronounced fragmentation or the landscapes are modified or partially modified, they are intensively used for agriculture or production and the natural areas are small in size and are fragmented or pronounced); Diversity of landscape elements (uniform landscape predominates or landscape is diverse (different landscape elements, groups of landscape elements are visible or a large variety of landscape elements (in terms of shape, colour, size) is visible); Movement (static, silent or noisy, with heavy traffic creating a constant noise in the landscape; Genius loci (not readable, readable in individual elements or viewpoints, or readable expressively or even at several levels of perception (architecture, atmosphere, nature, etc.)
- Landscape values - Rarity (common, rare, peculiar or unique); Typicality, uniqueness (typical or unique at national level); Associations (no intangible cultural values, or some intangible cultural values, or the area has certain local traditions, a strong cultural space).

On the other hand, the visual qualities of the landscape are characterised by visual perception - Scale of perception (small/closed/intimate; medium/limited openness or large/wide/open); Openness of the landscape (open landscapes with distant and wide views or limited views); High quality views and scenic roads (no or many high-quality views and scenic roads and a variety of scenic roads and sections).

Landscape sensitivity can be used to assess the susceptibility of a landscape to a particular type of change or development. It is an important process for planning for change in a particular place, taking into account the interaction between the landscape itself, its perception and the specific nature of the type of change or development in question. Although the landscape is constantly changing and influenced by the actions and decisions of society as a whole and of individuals, it is possible to identify key spatial development directions that are strategically planned and guided in local authority development documents. It should be noted that the landscape sensitivity criteria may be refined and/or supplemented, as well as randomly selected in the case of different landscape development directions/scenarios.

Considering the spatial development directions for the short and long term set by Latvian municipalities in strategic spatial development planning documents, potential spatial development scenarios have been presented which, if applied in a given area (landscape area), may lead to further landscape changes. In the process of landscape assessment, it is important to provide (practical) recommendations for mitigation measures, the implementation of which can help to mitigate irreversible changes in the landscape, contribute to the restoration and maintenance of the historic and existing condition, or improve the quality and value of the landscape.

In order to determine the sensitivity of the landscape of a specific landscape area to potential changes in the spatial unit of the landscape, a landscape assessment was carried out within different potential development directions/scenarios for the area. As different development processes affect biophysical and visual qualities differently, all or some of the proposed landscape sensitivity criteria can be used to assess sensitivity, assessing on a case-by-case basis what most directly affects landscape sensitivity under potential change and what should be addressed under the chosen development scenario. The sensitivity threshold for a given spatial landscape unit is derived from the dominant characteristic of all selected landscape sensitivity criteria on the rating scale, which then also constitutes the sensitivity threshold for that spatial landscape unit, describing the sensitivity of the landscape to the specific dimensions of landscape sensitivity.

Results

In Latvia, landscape assessment has been carried out for all landscape areas, assessing the sensitivity of a particular spatial unit of landscape to different potential changes under different development directions/scenarios. The following is a description of the potential development scenarios analysed and the common sensitivity characteristics, referring to a general analysis of the situation in the landscape areas, assessing the criteria of landscape character and visual quality, and providing conditions for determining landscape sensitivity.

Formation or intensification of agricultural lands and agricultural production, which includes transformation of forest land, conversion of permanent grassland into arable land, consolidation of individual agricultural land, removal of individual clusters of trees, bushes, demolition of individual farmsteads (in sense of marginalisation).

Characteristics and conditions for determining landscape sensitivity (Fig.4) - a landscape is less sensitive if it is already visually dominated by agricultural production buildings and clearly perceptible agricultural areas; high-value agricultural areas are less sensitive to agricultural intensification; green corridors are an important element in agricultural land, the more developed the green corridors, the less sensitive the landscape; biodiverse areas, tree clusters, watercourses and water bodies that need to be preserved and/or developed, created are important landscape elements that make the landscape sensitive; the development of energy crops increases the sensitivity of the landscape; the landscape is more sensitive if it contains cultural monuments.

Afforestation, the creation of new forest stands, which involves afforesting land that is not or is not suitable for agricultural use.

Characteristics and conditions for determining landscape sensitivity (Fig.5) - the sensitivity of a landscape is influenced by its degree of visibility, and the more landscape with distant and prominent views from roads, the more sensitive the landscape; the larger the area of agricultural land with high soil fertility, the more susceptible the landscape is to afforestation; reclaimed agricultural land is susceptible to afforestation, when planning afforestation of an area, consideration

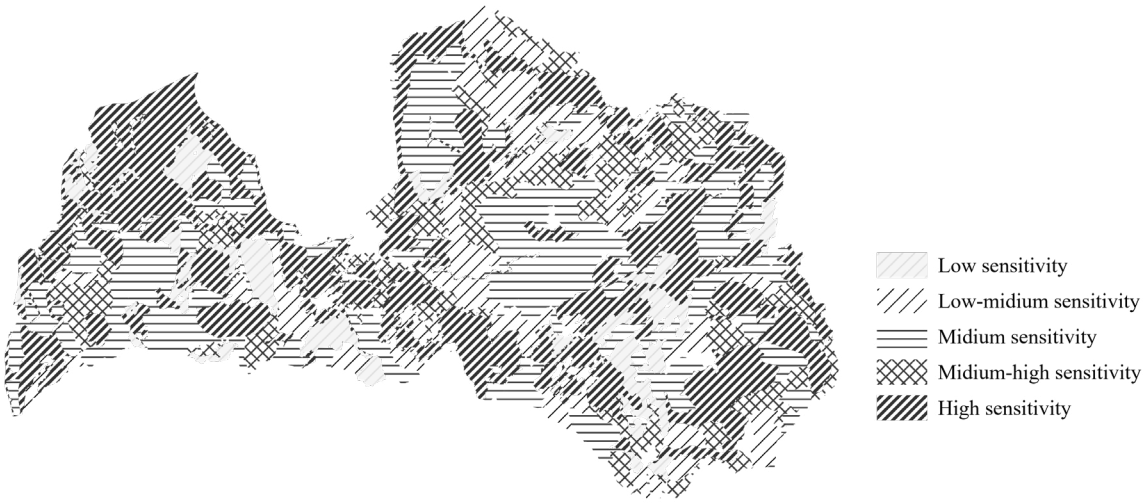

Fig. 4. Landscape sensitivity to formation or intensification of agricultural lands and agricultural production [created by authors]

Fig. 5. Landscape sensitivity to afforestation [created by authors]

should be given to whether high quality views from public vantage points and cultural monuments (churches, manor houses, avenues, etc.) will be obstructed; the more specially protected natural areas (protected habitats, habitats of specially protected species, biologically valuable grasslands), the more sensitive the site.

Development of settlements (low-rise residential and small-scale industrial), more specifically in the case of landscape sensitivity to the development of buildings, low-rise residential buildings and small production facilities clustered (more than 3 buildings, up to 3 stores in height), new settlements or proposed extensions to existing development that significantly change the area and/or intensity and spatial structure of existing development.

The characteristics and conditions for determining landscape sensitivity (Fig.6), or the conflict situations in which landscape sensitivity manifests itself, are as follows:

- The scale of development is inappropriate to the existing scale of the landscape;
- The development dominates the landscape and creates disharmony;
- The character and style of the development is inconsistent or in conflict with the existing identity/character of the landscape;
- Buildings obscure valuable views;
- The development creates narrow 'visual corridors' in the streetscape;
- The development encroaches on the boundaries of a heritage landscape;
- Development encroaches into a valuable natural landscape;
- The development boundary is not gradual;
- Development breaks up green corridors in the landscape;
- Development fragments the existing spatial structure of the landscape.

Development of transport and engineering infrastructure, including development of railways, main national roads, flyovers, noise barriers/fences, overhead power lines up to 110kV where existing, as well as completely new transport and engineering infrastructure.

Characteristics and conditions for determining landscape sensitivity (Fig.7) - the landscape will be less sensitive to the development of new transport infrastructure in areas where existing transport infrastructure already exists, with provision for its reconstruction or improvement, and where new development makes maximum use of existing infrastructure routes and channels. On the other hand, the creation of entirely new infrastructure should take account of local conditions and avoid direct visual fragmentation of the landscape that changes its character or identity.

The integration and construction of large-scale production facilities (large-scale biogas plants, industrial wind farms, industrial solar farms) into the landscape changes the

Fig. 6. Landscape sensitivity to development of settlements [created by authors]

Fig. 7. Landscape sensitivity to development of transport and engineering infrastructure [created by authors]

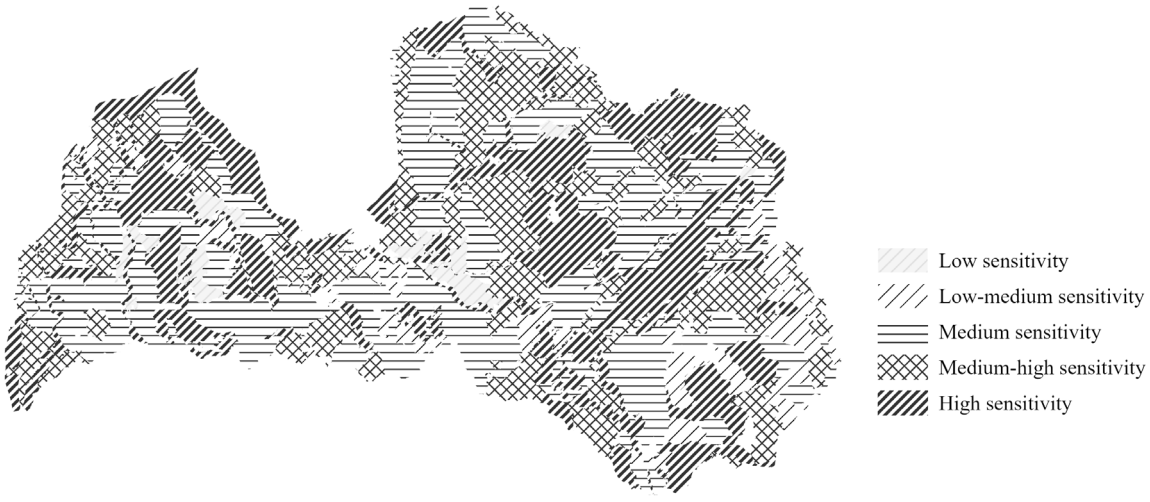

Fig. 8. Landscape sensitivity to the integration and construction of large-scale production facilities [created by authors]

overall appearance, identity and visual quality of the landscape. Therefore, a detailed feasibility study and landscape assessment (viewpoints, silhouettes, conflict points, etc.) is needed to identify the high value areas of the landscape that need to be preserved in their current state and quality, without losing their values, status and adjacent cultural monuments.

Characteristics and conditions for determining landscape sensitivity (Fig.8) - larger-scale landscapes will be less sensitive to changes resulting from the integration of large-scale production facilities, while landscape with smaller scales or with more distinct topography will be more sensitive to changes resulting from the integration of large-scale production facilities into the landscape.

Fig. 9. Landscape sensitivity to development and seasonal flows of tourism and recreation infrastructure [created by authors]

Fig. 10. Landscape sensitivity to the potential for the protection of natural areas and values [created by authors]

Development and seasonal flows of tourism and recreation infrastructure (leisure and recreation centres, campsites, guesthouses), i.e. development of various types of tourism and recreation infrastructure, including consideration of tourist and visitor flows and their seasonal nature (intensity and conditions of use of the site).

Characteristics and conditions for determining landscape sensitivity (Fig.9) - tourism is a sector that does not directly affect the extraction of a resource, but does affect its use. Particular attention should be paid to the organisation of tourism flows in heritage and nature conservation sites, ensuring their proper conservation while at the same time using them for education and learning.

The potential for the protection of natural areas and values is a scenario that outlines the possible development of a landscape area or part of a landscape area, giving priority to nature or landscape conservation, where appropriate spatial development should be planned, taking into account human impacts and risks on specially protected areas (SPA) or sites, and minimising the risk of fragmentation of these areas. Depending on the purpose of the SPAs or sites in the area (e.g. landscape or protection of a specific species or habitat), the scenario can range from ensuring the full nature conservation function to the possibility of combining nature conservation with nature tourism.

Characteristics and conditions for determining landscape sensitivity (Fig.10) - sensitivity is influenced by the conservation status and objectives of the natural areas within the site, the extent and interrelationship of these areas.

Conclusions and Discussion

Thanks to the European Landscape Convention, landscape as a resource has gained a stronger place in spatial planning in many European countries and is now widely recognised for its contribution to both social well-being and sustainable development. Despite its apparent abstractness, landscape, through its physical presence and its psychological aspect, meets important social and cultural needs, as well as fulfilling ecological and economic functions. This combination of characteristics, reflecting the diversity of landscape functions, is unique.

Landscape impacts and their intensity or lasting changes may vary considerably from place to place in Latvia, characterised by different site, ecological, geological, land use, vegetation (vegetation), water resources (or their availability), cultural or visual features, or a variable combination of these features.

The characterisation of landscape sensitivity in potential development scenarios takes into account not only the visual-spatial perception of the site, but also the ecological, aesthetic and cultural-historical values of the landscape spatial unit. A finding of 'high' sensitivity does not mean that

no development is possible, and a finding of 'low' sensitivity does not mean that there is definite development potential. The Landscape Sensitivity Assessment provides additional information for some types of development within the spatial planning framework.

Based on the sensitivity of the landscape to different types of development scenarios in a given location, it is possible to set landscape quality objectives, as mentioned in the European Landscape Convention, which invites European countries to set their own landscape quality objectives, defined as "landscape-specific ... public expectations, formulated by the competent public authorities, regarding the landscape characteristics of their neighbourhood". It is necessary to identify the essential needs and aspirations of stakeholders in the use of a particular landscape, and the opportunities (sensitivity and development potential) of a particular landscape to meet these needs and aspirations, by setting specific landscape quality objectives and incorporating them into local development planning documents, such as landscape thematic plans, which are used as a basis for zoning. The landscape quality objectives then become a reference point for land and sectoral policies, for the work of various organisations and for society as a whole to continue moving towards an area with a sustainable landscape that has a positive impact on the quality of life of local residents and visitors to the area.

It is important to convince the public and decision-makers of the current and potential richness of all landscapes and the need to take this into account in all policies.

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Kopsavilkums

Eiropas valstīm ir atšķirīga pieredze ainavu raksturošanā un novērtēšanā. Salīdzinot dažādās Eiropas valstīs izmantotās pieejas, tiek piedāvāts izmantot Lielbritānijā izstrādāto un apstiprināto metodi - Ainavu raksturojuma novērtējumu, kas pielāgota un modificēta Latvijas situācijai. Šī pieeja ir izmantota arī lielākajā daļā citu Eiropas valstu, kuras ir izvēlējušās izmantot Apvienotās Karalistes pieeju ainavu raksturošanai, pielāgojot to savai konkrētajai valsts situācijai. Latvijas ainavu novērtējuma nepieciešamība ir uzsvērta Latvijas ainavu politikas pamatnostādnēs 2013-2019 un Latvijas ainavu politikas īstenošanas plānā 2024-2027, ņemot vērā Eiropas ainavu konvencijā noteiktos pasākumus, kas jāveic visām konvencijas dalībvalstīm. Pētījuma mērķis bija veikt Latvijas ainavu jutīguma analīzi vietējām pašvaldībām nozīmīgu teritorijas plānošanas scenāriju ietvaros. Ļoti svarīgi ir novērtēt ainavu jutīgumu ņemot vērā apbūves un dabas vides pārmaiņas, kas ietekmē Latvijas lauku teritoriju attīstības tempus un mērogu. Tā kā vietējās pašvaldības izvirza atšķirīgus telpiskās attīstības mērķus, ainavu jutīguma analīzei Latvijas ainavās tika izvēlēti kopīgi telpiskās attīstības scenāriji. Ainavu jutīguma analīzes rezultāti liecina par to, ka dažādās Latvijas vietās ir atšķirīgi īstenojami piemēroti pasākumi. Rezultātus var izmantot arī ainavu kvalitātes mērķu noteikšanai, lai saskaņotu Latvijas pašvaldību īstenojamo pasākumu apjomu.