

LANDSCAPE SPATIAL UNIT IDENTIFICATION METHOD FOR LANDSCAPE CHARACTER ASSESSMENT IN LATVIA

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Abstract. This research develops and applies a comprehensive method for identifying landscape spatial units to support landscape character assessment in Latvia. The approach is based on the integration of geomorphological, land-cover, land-use, ecological, and cultural-historical data, complemented by field-based perceptual evaluation. A national spatial database was created by compiling open geospatial datasets from state institutions and compiling them through GIS processing, including multi-scale data interpretation, overlay analysis, and refinement of boundaries. Three hierarchical levels of spatial landscape units were defined: landscapes - large-scale landforms, landscape areas, and landscape character areas - the latter representing the smallest and most perceptually meaningful units for planning and management purposes. Landscape character types were established using a combined classification of relief, land-use patterns, vegetation structure, mosaic complexity, and distinctive features such as wetlands, river valleys, or dune systems. In total, 15 landscape character types were identified and described, reflecting visually recognisable and homogeneous patterns in the terrain. Field surveys conducted in 2022 verified and refined the GIS-generated boundary delineations, while also documenting landscape perception and key visible characteristics within each landscape character area. The results demonstrate that boundary precision depends on scale and that landscape transitions often occur gradually rather than abruptly, particularly in mosaic or water-related landscapes. The applied GIS methods proved effective in ensuring spatial transparency, enabling simultaneous interpretation of multiple data layers and supporting iterative refinement through expert assessment. This study provides the first national-scale, perception-based identification of landscape spatial units for Latvia and establishes a methodological framework for future landscape planning, management, and policy development. The resulting classification and cartographic materials support differentiated planning solutions tailored to specific landscape character types and areas. **Keywords:** landscape character assessment, landscape character areas, spatial unit identification method

Introduction

Landscape, as a complex system, encompasses a wide range of scientific disciplines, including geography, archaeology, anthropology, ecology, and others. Each discipline formulates its own definition of landscape, emphasizing aspects that reflect its particular research interests. At the same time, landscape, as the living environment of people, brings together all these diverse fields, viewing landscape through the lens of human perception. Therefore, in the sections of this book, the definition of landscape used is the one provided in the European Landscape Convention: "Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" [1].

Landscape is both a socio-economic and biological resource, as well as a living environment for people, reflecting cultural-historical values, traditions, and the more intangible qualities of landscape shaped by memories, associations, and the

representation of landscape in art, music, and literature. Considering the importance of human perception, the landscape quality objectives or the expectations set by different social groups toward a particular landscape play a significant role in landscape assessment [1; 2].

One of the key insights emphasized by European landscape researchers is that landscapes have no fixed boundaries. Therefore, there is no single prescribed approach for subdividing landscapes into smaller spatial units, and each country may apply its own method. Likewise, European and global experience show that incorporating the human-perception dimension into landscape assessment, as highlighted by the European Landscape Convention, requires a crucial consideration of scale when defining the smallest landscape spatial unit. This unit must be perceivable and understandable to people, while still retaining the holistic perception of the landscape. However, for strategic and

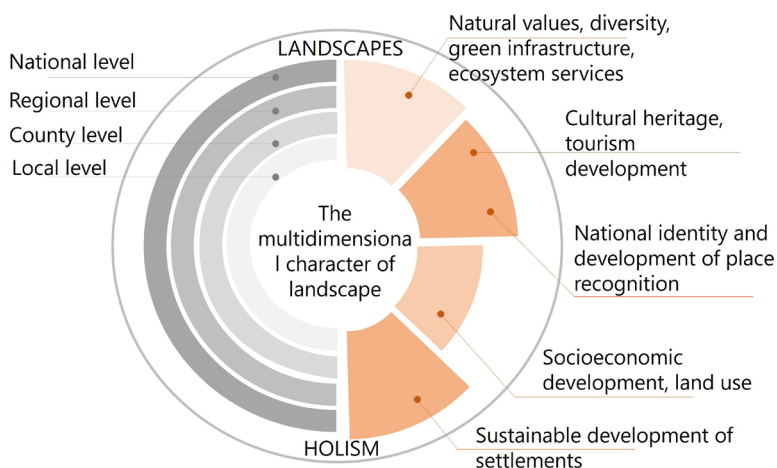


Fig. 1. Landscape as a complex system is defined by its multidimensional character and the diverse fields that shape it, by the holistic perception of landscape, and by the differing landscape quality objectives, namely, society's expectations toward the landscape at various planning levels [created by the authors]

integrated management purposes, the smallest landscape units are subsequently grouped into larger ones that reflect the physical–geographical, economic, and social specificities of a given region, characteristics that become visible in the landscape character (for example, intensive agricultural areas, coastal regions, etc.) [1; 3].

Despite the requirements of the European Landscape Convention, only a few countries across Europe (France, Italy, Switzerland, the Netherlands, Belgium, Great Britain, and Latvia) have a systematic knowledge of the landscape characters at the national or regional level [4]. In Latvia, landscape character assessment was done in the framework of the project „Sustainable management of land resources and landscapes: assessment of challenges, methodological solutions and proposals “(LandLat4Pol) [5].

When analysing the experience of European countries in landscape assessment and mapping, three fundamental principles can be identified:

- Assessment of the landscape as a “unified whole” (the holistic approach), which primarily includes methods related to human perception (both visual and cognitive) and public participation, while at the same time examining the landscape comprehensively through various additional dimensions.
- Characterisation and assessment of the landscape based on its geomorphological and ecological qualities and land-use patterns.
- Landscape assessment grounded in the statistical analysis of landscape elements or specific attributes, using a pre-defined value scale for each parameter.

It is important to the process of Landscape Character Assessment, and therefore to classifying and describing the landscape, to understand the distinction between landscape character types and landscape character areas. These terms need to be used correctly, and the differentiation between types and areas, identified at different levels in the hierarchy from national to local, needs to be understood.

Landscape Character Assessment (LCA) can be carried out at a wide range of spatial scales, from broad national overviews to detailed site-level studies. In practice, three

main levels are commonly distinguished. First, at the national or regional scale (approximately 1:250,000), major variations in landscape structure and character are identified, providing an overarching framework for more detailed assessments. Second, at the local authority level, for example, counties, districts, or unitary authorities, LCAs are typically undertaken at scales around 1:50,000 or 1:25,000, allowing the identification of specific landscape types and character areas. Because landscape patterns extend across administrative boundaries, methodological consistency between neighbouring jurisdictions is critical at this stage. Third, the most detailed assessments are conducted at the local or site scale, usually at 1:10,000 or finer, when evaluating specific sites, development areas, or projects. If needed, assessments may also be positioned between these levels or carried out at even more detailed scales [4].

Land use and landscape are closely interconnected. The landscape shapes or determines the type of land use by influencing the activities that can take place in a specific location, while land-use practices can also shape the landscape in return. When land use and landscape interact, they form distinct character areas. Landscape types can be identified through knowledge of the geophysical. Similarly, land use is characterized by dominant surface types, structural and/or historical patterns, and vegetation structures. By comparing land parcels across a region, it is possible to distinguish areas such as peatlands, grasslands, and arable land. Land use and landscape often intertwine, giving each area its characteristic distinctiveness and/or uniqueness [6].

When defining the boundaries of a landscape character study, it is essential to consider the wider geographic context rather than relying solely on administrative limits, as landscape patterns and visual relationships often extend across borders. Coordination with neighbouring areas, including reviewing or aligning their existing assessments, helps ensure that character units connect seamlessly and reflect shared vistas, landforms, and ecological linkages. The study area should also be adjusted to reflect the specific purpose of the assessment, such as renewable energy planning or protected area management, while still including adjacent zones that

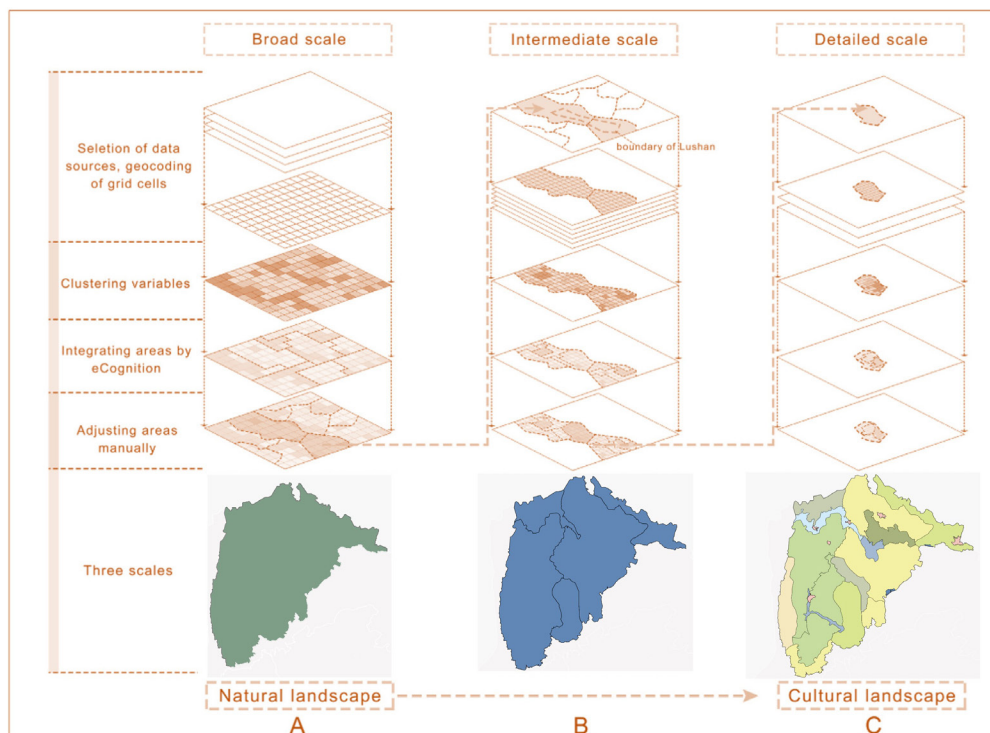


Fig. 2. Four steps/ processes to identify landscape character types and areas at three different scales, “Ziemeļvidzeme” example [created by authors, based on [7]

may influence or benefit from the landscape's visual and spatial qualities [4, 6, 8].

The identification of landscape character areas involves determining both their key features/characteristics and distinguishing transitions from surrounding or adjacent areas. To enable the use of qualitative landscape character information in planning and management, it must be associated with geographically bounded territories. Therefore, delineating landscape character units is essential, understood as structurally, functionally, and/or visually coherent areas to which differentiated protection, management, or planning regimes can be applied. It must be recognised that the precision of boundaries will vary depending on the assessment scale and level of detail [8; 9; 10].

Landscape boundaries are not always strictly definable. From the perspective of boundary theory, they can be regarded as transition areas. Landscape character is defined by context, and in many cases, clear boundaries between one landscape character (dominant) area and another are not perceptible, meaning delineation is based on the context relevant at a given moment. It may be said that the boundary between two landscape character areas occurs where it is least clear which character type dominates, since landscape is, in reality, continuous and character does not usually change abruptly (with exceptions related to certain geomorphological forms) [8; 9; 10; 11].

Method

The indicator groups included in the Landscape Atlas will be composed of hydro-geomorphological indicators (presence of water, characteristics of relief, etc.), natural potential indicators (protected nature areas, ecosystem complexity and diversity, green infrastructure, etc.), agricultural potential indicators, architectural and settlement evaluation, territorial development indicators (accessibility, building density and dynamics, etc.), intangible heritage indicators (including tourism characteristics), and others. These will be based on data from the Central Statistical Bureau of Latvia and on researcher-defined indicator groups with classified parameters.

Process includes:

- acquisition, editing, adaptation, and scaling of source data (including GIS);
- interpretation of overlays of selected landscape character layers; selection of criteria for identifying landscape types;
- characterisation of selected landscape types (at national, regional, and local levels);
- classification of attributes for the physical identification of landscape types and units;
- training on a unified approach to on-site landscape assessment;
- selection and field survey of pilot areas using a chosen identification checklist for assigning territories to defined landscape types;
- mapping of territories according to selected landscape types, definition, and description of local specificities.

In this research, used term "Landscape character types" is understood as distinct kinds of landscapes that are relatively homogeneous in character. Landscape character types are general in nature, as they may occur in different areas across various parts of the country; however, regardless of where they are located, they share similar overall combinations of geology, topography, drainage patterns, vegetation, historical land use, and settlement structures [5; 8]. And "Landscape character area" is defined as – a geographically delineated

area that is homogeneous concerning its relief characteristics and landform attributes [5; 12; 13].

A key prerequisite for defining spatial units is the compilation of available data on Latvia's landscapes, including their classification, the compilation of data formats, and the evaluation of spatial coverage and representation. A spatial database was created from the available datasets, forming coherent data groups on Latvian landscapes and the indicators characterising changes. This database serves as the basis for identifying different types and levels of landscape spatial units and for defining their mutual boundaries. The development of the landscape character type classification and descriptions was carried out by drawing on previous research conducted in Latvia and adapting it to the scale of the landscape area.

The next step involved the creation of cartographic material based on the collected data, ensuring spatial representation across Latvia. The processed information was digitalised and compiled into a unified spatial database to serve as the foundation for map production. Based on the processed datasets and the established landscape character type classification, initial cartographic material was prepared, outlining a potential division into landscape areas, identifying territories with different landscape character types, and marking their potential spatial boundaries.

This was followed by field surveys of the landscape areas. The surveys were conducted in 2022, with landscape assessment experts working in pairs. Fieldwork aimed to verify the correspondence of previously obtained and processed information to actual conditions, as well as to gather additional landscape-perception data that can only be acquired through direct site visits. In the landscape characterisation process, it is essential to confirm that the cartographic information corresponds to real-world conditions; therefore, this verification is carried out through field research. A field survey form is developed for this purpose, including a wide range of landscape-characterising parameters. Field surveys are also necessary to obtain information about landscape perception in a given area. The fieldwork is supplemented by on-site photographic documentation, which captures the character of each location and allows for later visualisation of the field observations, clearly demonstrating the qualities of each landscape spatial unit or the distinctive landscape-forming elements that differentiate it from adjacent units.

After the field surveys, the cartographic material of the landscape spatial units is refined. Based on the information collected during fieldwork, the previously prepared cartographic material is updated regarding the spatial arrangement of landscape units, including refining their boundaries according to the visual qualities of the landscape and its perception in the specific location. The refinement of boundaries begins with the landscape spatial units closest to the local scale (landscape character areas), and based on these adjustments, the boundaries of higher-level spatial units (landscape areas and landscapes – large-scale landforms (fig.3)) are also updated. To ensure efficient data processing, a geographic information system (GIS) approach was selected. This enables spatial transparency of all available data by simultaneously viewing and analysing the overlap of different spatial layers, as well as processing these data using various GIS software applications.

The compiled data can be categorised in several ways: by scale/resolution, by format, by data source, and by basic territorial data versus data generated through the landscape research process. The basic data consist of datasets provided by various institutions or downloaded from databases,

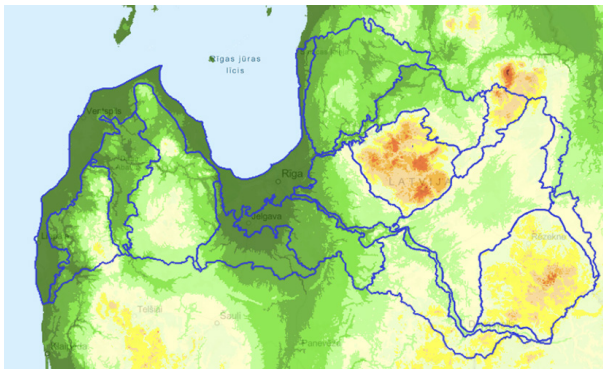


Fig. 3. Landscapes - large-scale landforms (in Latvian - *Ainavzemes*) [created by authors using, 14]

for example: land use, which is directly affected by human economic activities; natural and cultural heritage values; road and tourism infrastructure; water resources; and other characteristics. Detailed information on the datasets used in the production of the digital Landscape Atlas of Latvia can be viewed within the framework of the national research programme (2020–2023). Particularly useful are WMS services, which allow viewing current and the most up-to-date geospatial data published by different organisations. The map browser developed by the Latvian Geospatial Information Agency provides a wide range of maps as open data, from which the following were used in defining landscape character areas: geomorphology, administrative boundaries, and toponyms[15]. Latvian State Forests also offers open data in various layers, from which the following were used: relief (contour lines) and tourism information, including information on long-distance tourism routes – *Mežtaka*, *Jūrtaka*, and *Ezertaka* [16]. Land cover data were used from datasets produced within the frame of the Copernicus Land Monitoring Service [17]. Information on catchment basins and land drainage systems is available in the Melioration Cadastre Information System [18]. In Latvia, data on land-use types are compiled in the Geoportal, which serves as a single access point for Latvian geospatial information and services [19]. A diverse range of data on natural values was used from the nature data management system “OZOLS”, which stores information on specially protected nature territories, micro-reserves, protected species and habitats, management measures, tourism infrastructure in protected nature areas, biodiversity monitoring data, and other data relevant to nature conservation[20]. Data on cultural heritage were obtained from the “Mantojums” information system, which includes data on cultural monuments and protection zones [21]. Some layers are available from several of the sources above, and additional layers were later used in preparing detailed descriptions of the respective territories.

It is necessary to align landscape character areas with the spatial landscape units previously defined in Latvia, based on geomorphological criteria and land-cover distributions. The selected scale reflects both the level of territorial precision and the degree of generalisation. The accuracy of defined spatial landscape units depends on the scale and resolution of the available data. It is essential to acknowledge that details are lost in the process of generalization because their relative significance diminishes. The refinement of landscape land and landscape district boundaries was carried out by the Institute of Agricultural Resources and Economics (AREI) within the framework of the LandLat4Pol project. The initial delineation of landscape area boundaries was performed by AREI, with subsequent refinement by the Landscape Architecture and Environmental Engineering Institute of Latvia University of Life Sciences and Technologies.

Results

Landscape character area (in Latvian - *Ainavu areāli*)

One of the tasks of the National Research Programme project LandLat4Pol was to carry out the characterisation and assessment of Latvia's rural landscapes. In line with the emphasis placed on the landscape definition of the European Landscape Convention, it was established that the landscape characterisation must include the component of landscape perception, which significantly reduces the scale at which landscape spatial units have traditionally been studied. also corresponds with the contemporary understanding, highlighted in spatial development planning documents, that landscape represents the living environment of every individual, something that can be perceived, planned, and managed.

The landscape area was introduced as the lowest-level landscape spatial unit. A landscape character area is a spatial unit that a person is able to perceive and comprehend, and which is experienced as visually distinct from the neighbouring area (Fig. 4).

The main distinction of each landscape character area is defined by its landscape character type, which is shaped by landform, land cover, and land use. Additional differentiation is created by the specific features of each landscape character area, which are also easily perceivable, for example, the density of cultural heritage sites, the presence of particular habitats (swamps, biologically diverse forest areas, etc.), or the intensity of land management. At the level of landscape character area perception, it is essential to emphasise the connection with a specific, recognisable place or feature, as it is at this scale the scale comprehensible to people that the sense of belonging to a particular place develops.

However, it should be noted that the boundaries of landscape character areas are not always strictly definable, especially in mosaic landscapes, river or swamp landscapes, or landscapes with only subtly varying relief. Therefore, delineation is based on the contextual conditions present in the landscape at a given moment. It may be said that the boundary between two landscape areas is placed where it is least clear which landscape character type dominates, as in reality landscape is continuous and its character does not usually change abruptly (the main exception being the transition between forest landscapes and agrarian landscapes). In such cases, drawing a sharp line on a map does not reflect an actual boundary in nature. This needs to be taken into account later when the results of the landscape character assessment are evaluated and applied for landscape planning, management, or protection purposes. It is foreseen that the boundary zone of a landscape character area defined by a specific landscape character type is approximately 5 km wide, although this may change following more detailed GIS and field-based analysis. The division into landscape areas also facilitates territorial development planning and management, as it allows the identification of key issues and planning principles for each landscape character type group (for example, forest landscapes or river landscapes), followed by additional solutions tailored to the specific landscape character area with its unique characteristics (for example, an area with a high density of cultural heritage sites).

Given that human perception plays a crucial role in the identification of landscape character areas, the landscape character types used for characterising Latvia's terrestrial territory (including inland waters) within the research were developed based on what can be visually perceived and understood by people, excluding landscape components that are not perceptible for example, soil type, which influences

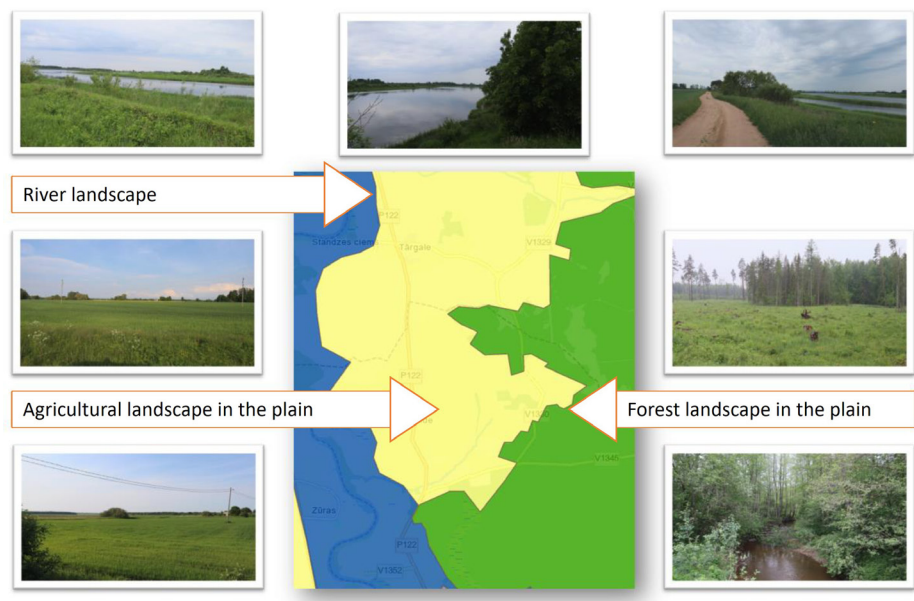


Fig. 4. Classification of landscape areas according to their visually distinctive landscape character types [Research Programme project LandLat4Pol]

Water and other landscapes		Plain terrain	Undulating terrain	Hilly terrain
↓		↓	↓	↓
River landscape	Agricultural landscape	Agricultural landscape in the plain	Agricultural landscape in undulating terrain	x
Lake landscape	Forest landscape	Forest Landscape in plain	Forest landscape in undulating terrain	Forest landscape in hilly terrain
Swamp landscape	Mosaic landscape dominated by forest	Mosaic landscape in the plain dominated by forest	Mosaic landscape in undulating terrain dominated by forest	Mosaic landscape in hilly terrain dominated by forest
Dune landscape	Mosaic landscape in dominated by agriculture	Mosaic landscape in the plain dominated by agriculture	Mosaic landscape in undulating terrain dominated by agriculture	Mosaic landscape in hilly terrain dominated by agriculture

Fig. 5. Landscape character types used subsequently in the characterisation of Latvian landscapes [created by the authors]

land cover and land use but is not visually readable in the landscape.
In total, 15 landscape character types were identified (see Fig. 5), defined by the following components:

- relief;
- land cover and vegetation;
- land use;
- unique features (e.g., river landscapes, swamp landscapes, etc.).

Landscape character types

The landscape character types were determined by further differentiating agrarian and forest landscapes according to dominant landforms, as well as by separately identifying mosaic landscapes, where agrarian and forest landscapes interact with varying intensity. In the case of water-related landscapes, river landscapes and lake landscapes were defined, along with swamp landscapes and dune landscapes as additional categories. Urban landscapes form a separate landscape character type, for which a different approach to characterisation is required.
Characteristic features and key distinctions have been identified for each landscape character type, allowing the differentiation between the various types. Below, each defined type is described in more detail. The type that was excluded is the agrarian landscape in hilly terrain, since there is no such landscape type in Latvia. This was clarified following pilot field surveys.

Landscapes in plain terrain

Agricultural landscape in the plain - a landscape character type dominated by agricultural landscapes, land used for farming. The structure of the agrarian landscape consists of extensive fields and meadows alternating with small, isolated forest patches and tree clusters; drainage systems are characteristic. Landscape elements with high visual and ecological value include rural settlements, farmsteads, and villages, as well as individual trees, tree groups, and avenues. Drainage ditches also form part of the landscape structure. Open and wide views dominate.
Forest landscape in plain - a landscape character type characterized by plain terrain and a high proportion of forest cover. Landscape diversity is determined by variations in tree species and age. The forest landscape structure consists of large forest massifs, within which agricultural land may appear as "islands." Landscape contrast is driven by diverse forest growth conditions. The character of the area is shaped by rides, roads, and drainage systems. Close-range, enclosed views dominate.
Mosaic landscape in the plain dominated by forest (forest cover > 50% compared to agricultural land) - a landscape character type where forest massifs and tree clusters alternate with agricultural land. The proportion of forested areas exceeds 50% relative to agricultural territories. Terrain is plain. Important landscape elements include farmsteads, natural meadows, and tree clusters. Views are predominantly short-range and enclosed, ending in forest massifs or farmstead clusters. Forest edges have an important role in

the landscape.

Mosaic landscape in the plain dominated by agriculture (agricultural land > 50% compared to forest) - a landscape character type where agricultural land alternates with forest massifs and tree clusters. The mosaic is formed by agricultural territories interspersed with forest stands, whose proportion is below 50% compared to agricultural land. Terrain is plain. Important landscape elements include farmsteads, natural meadows, and tree clusters. Medium-range views dominate, closing in forest massifs or farmstead clusters, especially when observed from open and elevated areas.

Landscape in undulating terrain, where characteristics are ridges and hills with gentle slopes and low relative elevation (<25 m), alternating with depressions.

Agricultural landscape in undulating terrain - a landscape character type dominated by agrarian land - agriculturally used areas. The landscape is homogeneous and open. Ridges are typically occupied by fields and pastures, while depressions contain meadows and tree clusters (up to 10% of the area). Some areas are drained. Farmsteads and villages are present. In some landscapes, parallel river networks occur. Open and wide views dominate, especially long-distance views from hilltops.

Forest landscape in undulating terrain - a landscape character type dominated by highly forested areas. Due to forest cover, the undulating relief is visible mainly in open areas (clear-cuts, natural openings) or along roads. Landscape contrast is created by diverse forest growth conditions. Rides, roads, and drainage systems shape the area. Farmsteads with adjacent agricultural land occur. Close-range, enclosed views dominate.

Mosaic landscape in undulating terrain dominated by forest - a landscape character type where forest massifs and tree clusters alternate with agricultural land. Forested areas exceed 50% of the territory. Forest edges, farmsteads, natural

meadows, and tree clusters are important elements. Views are short and medium-range, closing in forest massifs or farmstead clusters, especially when observed from open and elevated areas.

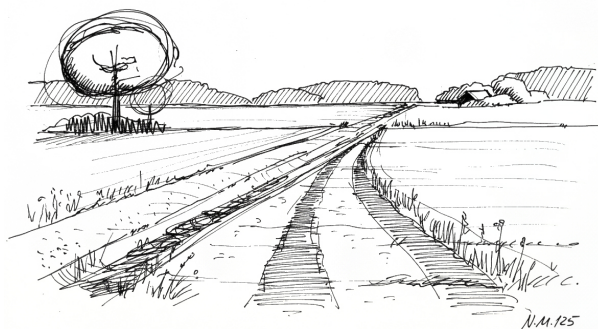
Mosaic landscape in undulating terrain dominated by agriculture - a landscape character type where agricultural land alternates with forest massifs and tree clusters. Forest cover is below 50% compared to agricultural land. Important landscape elements include farmsteads, natural meadows, and tree clusters. From higher, open areas, medium-range and wide views dominate, influenced by the scale of landscape mosaic perception. Forest edges play a significant role.

Landscape in hilly terrain

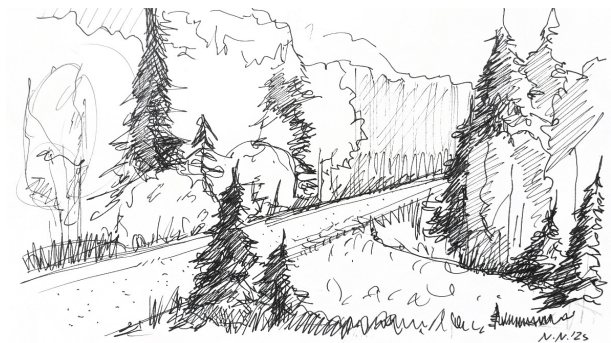
Forest landscape in hilly terrain - a landscape character type featuring relief typical of uplands - hills and hill ridges covered with forest. Hills and ridges are separated by depressions and broad, low-lying areas. Steep hill slopes are forested, while wet inter-hill depressions often contain meadows, swamps, or shrubland. Farmsteads with adjacent agricultural land occur rarely. Enclosed views dominate, ending in forest massifs. Long-distance views occur along road axes due to the expressive relief.

Mosaic landscape in hilly terrain dominated by a landscape character type with a fine-grained mosaic structure and high biological and landscape diversity. The alternating pattern of hills and depressions creates a large variation in soils, moisture, microclimates, and vegetation. The mosaic consists of forest stands (over 50% of the area) alternating with open agricultural land, mainly meadows and pastures. Steep slopes are forested; wet depressions contain meadows, swamps, or forests. Farmsteads blend into the landscape and do not stand out. Close-range, enclosed views dominate, with occasional wide and open views.

Mosaic landscape in hilly terrain dominated by agriculture



Agricultural landscape in the plain



Forest Landscape in plain



Mosaic landscape in the plain dominated by forest



Mosaic landscape in the plain dominated by agriculture

Fig. 6. Landscape character types used subsequently in the characterisation of Latvian landscapes



Agricultural landscape in undulating terrain



Forest landscape in undulating terrain



Mosaic landscape in undulating terrain dominated by forest



Mosaic landscape in undulating terrain dominated by agriculture

Fig. 7. Landscape character types in undulating terrain used subsequently in the characterisation of Latvian landscapes



Forest landscape in hilly terrain



Mosaic landscape in hilly terrain dominated by forest

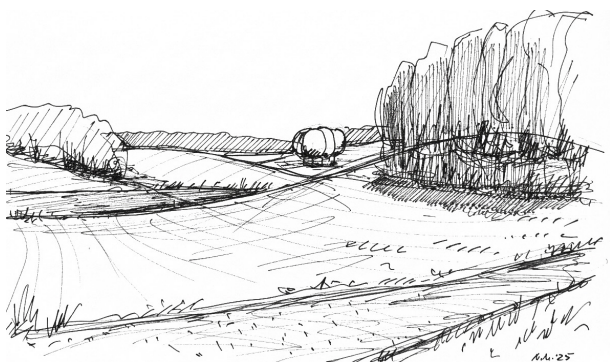
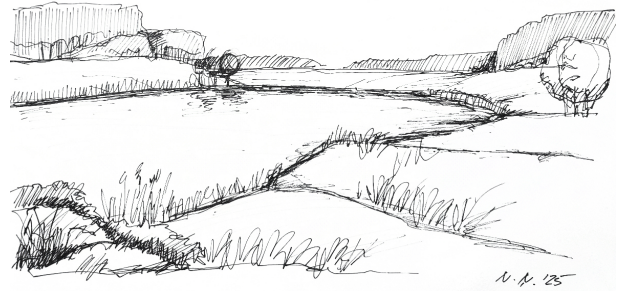


Fig. 8. Landscape character types in hilly terrain used subsequently in the characterisation of Latvian landscapes

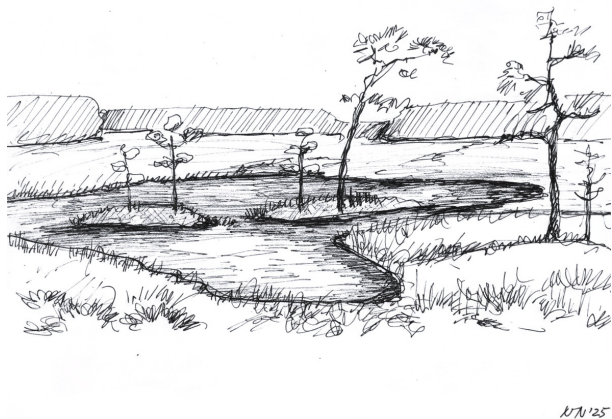
- a landscape character type with a fine-grained mosaic structure and high biological and landscape diversity. The alternating hills and depressions create strong contrasts in soils, moisture, microclimates, and vegetation. The mosaic consists of agricultural land (over 50 % of the area) alternating with forest stands. Use of open areas for farming is limited by steep slopes, fine-grained structure, and variable moisture. Gently elevated areas with favourable moisture are used for agriculture, while steep slopes and wet depressions are forested. Farmsteads are usually located near agricultural land and visually blend into the landscape. Wide and open views alternate with close and enclosed views. The landscape silhouette against the horizon is important.



River Landscape



Lake Landscape, including Wetlands



Swamp Landscape



Dune Landscape

Fig. 9. Other landscape character types used subsequently in the characterisation of Latvian landscapes

Other landscape types

River landscape (including ancient valleys and river valleys) - a landscape character type dominated by rivers and their valleys. River landscapes with gentle, indistinct banks, rivers have gentle valleys whose width greatly exceeds their depth. In plain terrain, rivers bordered by agricultural land or meadows clearly reveal their meandering (if preserved or restored). River landscapes with pronounced terraces and relief rivers are characterized by floodplain terraces. The valley floor consists of a floodplain, only partly occupied by the river channel. Riverbanks are mainly bordered by dense vegetation, forest massifs, and tree clusters with occasional open areas from which long views extend along the narrow, vegetation-framed river corridor.

Lake landscape, including Wetlands - a landscape character type dominated by a lake or visually and functionally connected lake chains. In uplands, relief consists of alternating hills and depressions, with lakes located in depressions, surrounded by meadows, forests, or tree clusters. In flatlands and lowlands, relief is plain, and lake shores are low and extensive. Shores are often swampy or drained. In some cases, polder systems have been created. Lakes may be visually hidden by forest massifs or dense shore vegetation. From certain locations, long and expressive view lines open towards the lake landscape.

Swamp landscape - a landscape character type dominated by swamps. Natural, undisturbed swamps are characterized by permanent or long-term water saturation, specific vegetation, and a unique landscape character. Terrain is plain or dome-shaped. Typical elements include bog pools and islands, hummocks, sparse pine or birch stands, and

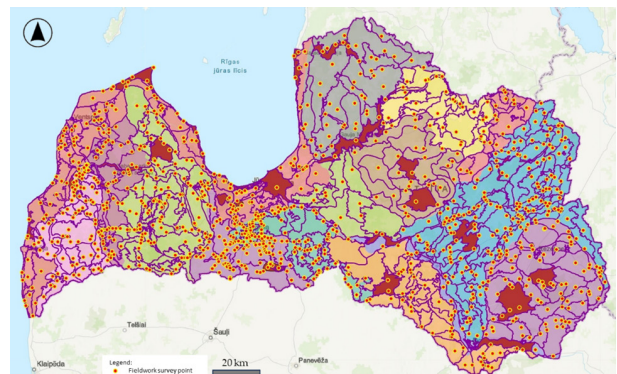


Fig. 10. Landscape character areas and field work points [created by the authors]

various sedge and moss species. Open, transparent tree cover shapes the view lines. Transformed, extracted swamps peat extraction areas have plain relief (sometimes at several levels). The landscape is open, structured by drainage ditches, technical access roads, and isolated buildings, with spontaneous vegetation in places. Some extracted swamps are used for agriculture (e.g., berry cultivation). Long open view lines dominate, ending in surrounding forest massifs.

Dune landscape - a landscape character type shaped by various dune forms embryonic dunes, foredunes, grey dunes, forested coastal dunes, and inland dunes. Dunes typically form ridge-like hills or hill chains.

Urbanized landscape (city) - urban areas as defined by the Law on Administrative Territories and Populated Areas. Villages, small villages, and farmsteads are considered elements within other landscape character types.

Conclusion

The scale of landscape character areas makes it possible to incorporate the dimension of human perception into landscape characterisation, which is essential for the subsequent use of the results in landscape planning and management approaches that aim not only to preserve natural values and cultural heritage, but also to enhance the quality of the human living environment. However, it should be noted that the scale of landscape character areas provides a conceptual and strategic framework for territorial development planning primarily, while the development of concrete solutions and tools requires a further level of detail in landscape spatial units. The selected GIS tools proved to be effective, providing spatial transparency of all available data by simultaneously viewing and analysing the overlap of different spatial layers, as well as enabling comprehensive data processing. This study provides the first national-scale, perception-based method for identifying landscape spatial units in Latvia, combining GIS-based analysis with field surveys to refine boundaries at a human-perceptible scale. The proposed three-level hierarchy of landscapes - large-scale landforms, landscape areas, and landscape character areas establishes a unified framework for planning, management, and landscape quality objectives at different administrative scales. The approach is replicable and can be adapted to other territories, depending on the availability and resolution of spatial datasets. The results can support territorial development planning, protected area management, cultural heritage evaluation, and green infrastructure strategies, enabling differentiated planning solutions tailored to specific landscape character types. However, limitations persist, particularly in mosaic and water-related landscapes where boundaries are gradual rather than abrupt, and therefore, additional field verification and stakeholder input remain essential. Future research should focus on improving indicator selection, incorporating long-term monitoring using digital survey tools, and developing participatory mapping approaches to strengthen public involvement in landscape character assessment and decision-making processes.

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Kopsavilkums

Šajā pētījumā izstrādāta un pielietota visaptveroša metode ainavas telpisko vienību identificēšanai, lai nodrošinātu metodoloģisku pamatu ainavas rakstura novērtēšanai Latvijā. Pieeja balstīta uz geomorfoloģisko, zemes seguma, zemes izmantošanas, ekoloģisko un kultūrvēsturisko datu integrāciju, papildinot tos ar lauka pētījumos veiktu ainavas uztveres novērtējumu. Izmantojot valsts institūciju nodrošinātās atvērtās ģeotelpisko datu kopas, tika izveidota nacionāla mēroga telpisko datu bāze. Datu apstrāde veikta ģeogrāfiskās informācijas sistēmas (GIS) vidē, ietverot dažāda mēroga datu interpretāciju, telpisko slāņu pārklājuma analīzi un ainavas telpisko vienību robežu precizēšanu. Tika noteikti trīs hierarhiski ainavas telpisko vienību līmeņi: ainavas – liela mēroga reljefa formas, ainavu apvidi un ainavas rakstura areāli. Ainavas rakstura areāli veido mazākās un no ainavas uztveres viedokļa nozīmīgākās telpiskās vienības, kas izmantojamas ainavu plānošanas un pārvaldības vajadzībām. Ainavas rakstura tipi tika noteikti, izmantojot kombinētu klasifikāciju, kurā ietvertas reljefa īpatnības, zemes izmantošanas struktūra, veģetācijas telpiskā struktūra, ainavas mozaikveida rakstura sarežģītība, kā arī specifiskas ainavas pazīmes, piemēram, mitrāji, upju ielejas un kāpu sistēmas. Kopumā tika identificēti un raksturoti 15 ainavas rakstura tipi, kas atspoguļo vizuāli atpazīstamas un relatīvi homogēnas teritorijas ainavas struktūras.

Pētījums sniedz pirmo nacionāla mēroga, ainavas uztverē balstītu ainavas telpisko vienību identificēšanas pieeju Latvijā un izveido metodoloģisku ietvaru turpmākai ainavu plānošanai, pārvaldībai un ainavu politikas izstrādei. Izstrādātā klasifikācija un kartogrāfiskie materiāli nodrošina pamatu diferencētu plānošanas risinājumu izstrādei, pielāgojot tos konkrētu ainavas rakstura tipu un ainavas rakstura areālu īpatnībām.