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The planning of green infrastructure using a three-level approach

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Abstract. In recent years, global research in spatial planning has focused on the sustainable development of green infrastructure (GI) in order to reduce the consequences of urbanization processes on the ecological, socio-economic and visual quality of the environment. Problems with stormwater management, floods, storms and global warming in general are just some of the reasons why GI planning has gained popularity. According to other current strategies (EU Biodiversity Strategy, EU GI strategy, Green Deal initiatives, etc.), GI plans, which include social, economic and ecological aspects, are being developed for territories of different scales. Until recently, green infrastructure was just an added value to real estate, but today it plays a completely different, much more important role. In Europe, the GI planning process has already begun, with several European countries developing GI plans in urban environment, different scales across country and even at national level.

Depending on the scale chosen, the principles of GI planning differ. In European examples, GI is considered in large-scale regional landscapes, where the green network and connections are formed from natural areas, but at the urban scale, the creation of GI goes hand in hand with the creation of a green network in the city, connecting the largest green areas with each other (squares, parks, urban forests, etc.). However, in the scientific literature, the basic principles and the correlation of GI planning at different scales have not been widely studied and analyzed. Therefore, the purpose of the article is to define the main principles in the planning of GI in Latvia using a three-level approach. Each level corresponds to a specific scale of the territory, starting with the regional scale, moving to rural and urbanized areas and concluding with the site scale. Each lower level is subordinated to the highest, thus forming a single GI planning system. At each level, GI key planning principles and prerequisites to be considered are defined.

The town of Aizpute, its neighboring villages and rural areas in Latvia were chosen as a case study territory for the article. Article discusses the planning of GI in the context of three levels and also the different approaches of GI planning in the rural and urban landscape.

Key words: GI, green network; spatial planning, three-level planning

Introduction

In recent years, more and more attention has been directed to the creation of green infrastructure (GI), green network or greenspace concepts and their positive impact in both urban and rural areas. It is highlighted and noted by several strategic documents – the EU Biodiversity Strategy for 2030, the EU GI Strategy and A European Green Deal [1; 8; 30]. The definition of GI can be explained as a mutual system of green structures that preserves the values and functions of the natural ecosystem and provides benefits to humanity [4; 28]. The issues of creating GI are closely related to nature protection and ensuring biological diversity, as well as obtaining social, cultural and economic benefits from natural resources. The industrialization of agriculture, the restructuring of land use, the construction of large transport networks and the expansion of cities have caused serious fragmentation of natural territories, loss of natural habitats and extinction of species, especially in densely populated European cities [9; 19]. Nowadays, there is more and more discussion about the processes caused by climate change, which also means greater threats of storms and floods. One of the solutions is to integrate rainwater accumulation, drainage and infiltration systems into the GI. The creation of well-thought-out GI in the urban environment also provides opportunities to reduce CO_2 and harmful emissions from transport, as it promotes the movement of citizens in an environmentally friendly way and improves public health in general. One of the ways to promote the public's stay in the outdoor space and its active use is the integration of pocket parks into the GI [20].

GI planning at different scales

Analyzing the theory and scientific articles on different scales of GI planning in natural and urban landscapes, it is possible to distinguish the main constituent elements, functions and benefits of GI, which are summarized in Table 1. The approaches to the creation of GI in the planning of territories of different scales are different and are determined by the goals and regulatory framework of each country, region or city. Although examples of GI creation for landscapes of different scales are common, GI as a system that integrates different levels – from regional to local - is not so widespread in practice. England [17] is one of the examples where such a system has been created, which includes landscapes of different scales, as well as all aspects – ecological, economic, cultural and social.

TABLE 1

The most frequently mentioned GI constituents and their benefits in theory and scientific articles

	Planning scale	Main elements of GI	Benefits and outcomes
National/ regional level	The National and regional planning level	Large-scale linkages (river corridors, forest massifs and belts, etc.) between important, larger green structures (natural parks, reserves, larger forest massifs, etc.) In certain cases, buffer zones with a lower intensity of use are applicable, which complement the GI	Ecological linkage Creation of a regional recreation network using linkages as movement corridors
	[6; 13; 14]		
County/ City level	The county planning level	The green network, which consists of separate larger forest massifs, water areas, natural meadows, etc. natural territories and biocorridors (edges of watercourses, alleys, natural vegetation strips separating properties, etc.).	Ecological linkage Improved biodiversity Reduced environmental threats – wind and water erosion The social and cultural benefits of GI at this level of planning, especially in rural areas, are scarcely addressed in the literature
	[6; 11; 13; 18]		
	Cities and villages	The green network, which consists of nodal points (parks, squares, important public outdoor spaces, etc.) and biocorridors (street greenery, edges of watercourses, etc.), which connect these nodal points into one system. Nodal points and biocorridors perform not only an ecological, but also a social and economic function.	Ecological linkage Improved biodiversity Improved environmental quality, reduced risks of rainwater floods The possibility of developing a tourism network, safe daily travel routes Quality living and working space, opportunity to attract investors and new residents
	[2; 4; 5; 11; 25; 27]		
Local / site level	Neighbourhoods	Nodal points as socially active centres of the neighbourhood and elements of place identity. Street greenery, watercourse edges, etc. as linkages that connect the neighbourhood's important greenspaces	Improved environmental quality, reduced risks of rainwater floods An opportunity to develop safe daily travel routes An opportunity to strengthen the identity and recognition of the place Citizen participation
	[2; 4; 5; 25; 27]		
	Scale of individual landscape areas	Separate zones and elements – elements of sustainable management of rainwater and floods, meadows, biologically diverse and site-appropriate greenery, elements involving community groups – pocket parks, urban gardens, community gardens, elements of environmental education	Improved environmental quality, reduced risks of rainwater floods Improved mental and physical health of the population Building a socially responsible and educated society
	[2; 25; 27]		

Examples and principles of GI creation at different planning scales and landscape types are discussed below. One example at the scale of national and regional planning is the GI Guidelines for England. The guidelines aim to develop GI to create places where people want to live and work. Infrastructure planning is recognized as an essential tool for high-quality planning of urban and rural areas. The example of England illustrates the multi-functionality of GI and the need to involve the public in the planning and implementation process. When developing and implementing projects, it is necessary to determine opportunities for the public to get involved in the projects as well, in order to promote responsibility and understanding of the specific place and its needs. Multifunctionality is a key component of the GI concept and approach, it refers to the ability of GI to perform a range of functions to provide a wide range of ecosystem services [15].

The county planning scale includes both urban and rural landscapes. Therefore, when planning GI on a regional or county scale, a broader view of elements and connections, wide river and road corridors, larger forest massifs or other large-scale blue-green elements are needed. The GI is then detailed even to the scale of a specific place, where walking paths, gardens and other small structural elements already have a detailed meaning. The infrastructure planning process should be able to spot potential sites that could be turned into part of the infrastructure, such as business parks with different eco-technological solutions or local homemakers with different types of agricultural approaches. At the county level, a good example of GI is the strategic framework for the East Midlands (England). The county strategy summarizes both the GI planning guidelines document for England reviewed above and adds new, more detailed sets of recommendations. The strategy distinguishes guidelines for the development of GI, towns and villages and rural areas of the entire county [27]. The planning document analyzes the wide range of benefits of GI - recreation, habitat provision and access to nature, development context, energy production and conservation, productive landscapes, flood mitigation and water resource management [3].

When planning the GI of cities and villages, the importance of the social environment increases – promoting public health and economic growth, while not diminishing the importance of the quality of the environment. The structure of the city has often been formed according to the conditions and elements of the natural environment of the specific place (near the river, mountain valleys, etc.), to which both the street network and the arrangement of green areas are subordinated [4]. By connecting larger areas of greenery and nature with street greenery and other green structures, the green network of the territory is formed. Therefore, the basic elements of GI are nodes or larger green structures (parks, squares, urban forests, etc.) and connecting linkages (street greenery, riverbanks, etc.), which mutually form a single green network [4; 5; 28]. If the main task of nodal points is to ensure ecological and functional quality, then connections ensure the continuity of processes (biocorridors or movement paths for various animal species, safe daily movement for people, etc.) [2; 4; 14]. On the other hand, the green network ensures the sustainability and resilience of the overall ecosystem.

As one of the most striking examples on the scale of city planning is Stockholm, where the GI was built already when the city was developing. Originally, the inaccessible green wedges were largely royal parks, land owned by royal families or for military use. These restricted access areas were then converted into recreational, forestry or agricultural areas. The green wedges start in Stockholm's city centre and extend into the countryside outside of Stockholm. The City of Stockholm is developing the "Green Map" as a land use planning tool. The map consists of three parts: habitat map, processing map and sociotope map. A sociocultural map introduces the concept of "sociotopes" into planning and is a way of managing sociocultural aspects. A sociotopus is a defined area (biotope or several biotopes) used for social functions (shore – bathing place, meadows – recreation area) [26].

In rural areas, more emphasis is placed on the already existing natural elements and structures. Agricultural land management is a way to influence the quality of GI. It is possible to ensure a better quality and quantity structure by diversifying the crops of agricultural lands and leaving wider uncultivated areas along the edges of the fields, allowing for an increase in the amount of biological diversity. At the scale of village planning, GI is a middle ground between urban and rural areas. In villages elements of GI are located in the centre of the village and are easily accessible.

The implementation of GI through community and public volunteering and active participation is addressed in the neighbourhood context. One example is the Mersey area in North West England. A major contribution to the process of planning, implementation and maintenance is responding to the existing needs of local residents. Community involvement in the Mersey example is organized by forming two groups: the official group, which is characterized by an official approach to management, taking into account various regulatory acts and regulatory documents; an informal group that uses a variety of promotional and seasonal

events to involve community and neighbourhood residents in volunteering for the creation and maintenance of GI [18].

Stakeholder engagement and the importance of the regulatory framework

GI planning requires close mutual cooperation (scientists, land owners, representatives of local governments, landscape architects, etc.). It is necessary to look for an opportunity to involve the citizens as well, to find out their opinion and wishes. Knowledge and awareness of such plans grow with each attempt to create such a concept, which gives the opportunity for further development of the method and process. [2]. In the programs that have successfully managed to involve the citizens, creative solutions are found to attract people's attention to the ongoing processes. Among the effective strategies for attracting people are posting green structure information in post offices, libraries, schools, city hall and other public institutions, working with the media, as was done in Anne Arundel County, Maryland (United States). The creation of a wetlands plan in West Eugene, Oregon used a number of citizen engagement techniques [4].

Planning of GI of territories in Latvia

In Latvia, there are few plans or activities directly related to GI, however, there is a large potential for GI that needs to be developed. The Latvian National Development Plan 2021-2027 includes the goal of maintaining natural capital as a basis for sustainable economic growth and promoting its sustainable use, while reducing natural and human risks to environmental quality. The plan also includes references to the use of GI in the urban environment to reduce flooding, erosion and solving environmental problems while improving the quality and attractiveness of outdoor space [22]. The sustainable development strategy of Latvia until 2030 mentions green corridors as an environmentally friendly and convenient part of transport within the city, and recognizes that the preservation of natural capital and ecosystem services in the future can create opportunities for Latvia, while the world's natural capital is shrinking [21]. The national biodiversity program does not clearly mention GI, but it includes the following goals: promote the preservation of traditional landscape structures, ensure sustainable use of natural resources, promote sustainable agriculture, create protected areas in coastal waters, protect forest habitats, reduce fragmentation and protect migration routes, creating a network of protected meadows of the highest biological value and integrating this network into physical planning [9]. In 1998, a plan was created – the ecological network of Latvia, which served as the basis for a network of green structures on a national scale. However, this initiative was only a draft and was never implemented.

There is no unified system by which urban planners, landscape architects or other specialists who deal with spatial planning could be guided in the development of GI in Latvia. There are only a small number of cities that have paid attention to the structure of greenery. Currently, greening concepts have been created for individual cities – Lielvārde (2006), Kuldīga (2013), Liepāja (2016), Rīga (2018) and Rēzekne (2020). In rural areas, the GI has been developed in the context of the Zemgale region [31], and its emphasis is mainly on the assessment of ecosystem services, preservation of natural and cultural values, improvement of biological diversity. Landscape ecological plans have been created for protected natural areas in rural areas, which also include GI elements, but mainly to ensure ecological functions.

The European Biodiversity Information System [7] stores data on the development of GI in various European Union countries. In order to ensure the completeness of GI in Latvia, two shortcomings are mentioned in the information system – lack of a general, strategic plan for the development of GI policy; lack of knowledge and understanding (especially at the municipal level) and public participation [16].

Analyzing both, scientific articles and examples from practice, it can be concluded that there is still a greater emphasis on the ecological functions and benefits of GI, which is also determined by the initial use of GI - to create ecological linkages in landscapes of different scales, which allows to ensure the stability of the overall ecological system. On the other hand, the social, cultural and economic qualities of GI have been discussed mainly regarding the urban environment along with the desire of cities to become greener in order to promote the activity of residents in the outdoor space, improve their health, and create high-quality public outdoor space that is attractive for tourism and investments. It is essential to pay more attention to linking the ecological aspects of GI with social, cultural and economic aspects not only in urban areas, but also in rural areas, thus promoting the use of these areas as well. Taking into account the movement in Latvia for the creation of GI in the planning of territories of various scales, the purpose of the article is to reflect the approaches and main criteria for the planning of GI at various scales and landscapes in the context of Latvia, looking at the Aizpute town and its neighbouring villages and rural areas as a case study.

Fig. 1. Aizpute town and its surrounding villages and countryside in the context of Latvia [map from https://geo.stat.gov.lv/stage2/]

Fig. 2. Bird's eye view to Aizpute town and its surrounding landscape [photo Varis Sants, 2014]

Materials and Methods

Case study object

Due to Aizpute district being a typical Latvian countryside reflection, with a historic town, several villages, countryside diversity and the location of villages surrounding the town of Aizpute, this district was selected as a case study object. The total area of the researched territory is 6399.0 km^2 [13]. In 2021, 8,083 inhabitants live in the territory [23].

The case study area is characterized by the alternation of higher and lower-level landscapes, which form a mosaic landscape with fields and forest areas. Between the landscape elevations are the Tebra and Alokste river valleys [12]. Agricultural areas occupy 49.9 % and forest areas 45.2% of the studied territory [12].

There are several valuable specially protected natural areas in the vicinity of Aizpute, including European significance, included in the unified network of protected areas of European significance Natura 2000 – nature reserve "Lake Blažģis" and nature reserve "Tebra oak forest". The studied territory is rich in various water objects – rivers, lakes, mill ponds, pond systems and systems of large water drainage ditches, in which water is stored permanently. There are 85 cultural and historical monuments of national and local significance in the area around Aizpute, one urban planning monument - the historical centre of the Aizpute town. The existing situation of the GI of the studied area is good when speaking about the quantity of elements.

Approach to develop a framework for GI planning process

By evaluating the approaches of different European countries in the planning and implementation of GI, a planning approach has been developed for the county scale, which includes the GI planning of the county, town, village and rural landscape.

In general, the planning, implementation and monitoring of GI of all scales and landscapes are based on the stages indicated in Figure 3. The article covers the first two stages, while stages 3-5 are the next steps for full GI implementation and monitoring.

According to the developed GI implementation stages, the first stage is the evaluation and survey of the existing situation. Mapped biologically valuable elements, specially protected natural territories, high-value landscape areas and protected landscapes, cultural heritage territories, as well as important recreational areas. The type of land use is indicated on the map – forest, water, built-up, agricultural. Data for the creation of the map are selected from publicly available databases and municipal territory planning documents [10; 19; 24].

The map helps to understand the structure of the landscape and to notice various problem areas (for example, excessively large areas of continuous agriculture), which can then be addressed with the help of GI planning. In order to promote a more active inclusion of social and cultural aspects in the county's GI planning scale, where until now ecological aspects were emphasized more, public accessibility of green areas is evaluated during the mapping process. The availability map allows to analyze in which areas the GI is available and sufficient, but where there is a potential need to develop green structures, but such areas are lacking. In order to analyze the accessibility of green areas, accessibility radiuses were drawn on the map around cities, villages and the largest settlements – 2.5 km, which is easily accessible on foot, 5 km, which is easily accessible on foot and by bicycle, and 10 km, which is easily accessible by car. or on a longer bike ride. Access zones were graded by assigning points according to their accessibility. Thus, it is possible to evaluate in which areas the green structures would be more significant and would be accessible to as many residents as possible. Accordingly, the values of the areas where the radiuses overlap are added, the larger the value, the more significant the area in question. In the public access scheme, the last step is to mark the already existing GI elements that fit within the radius boundaries, see Figure 5. The colouring is graded according to importance,

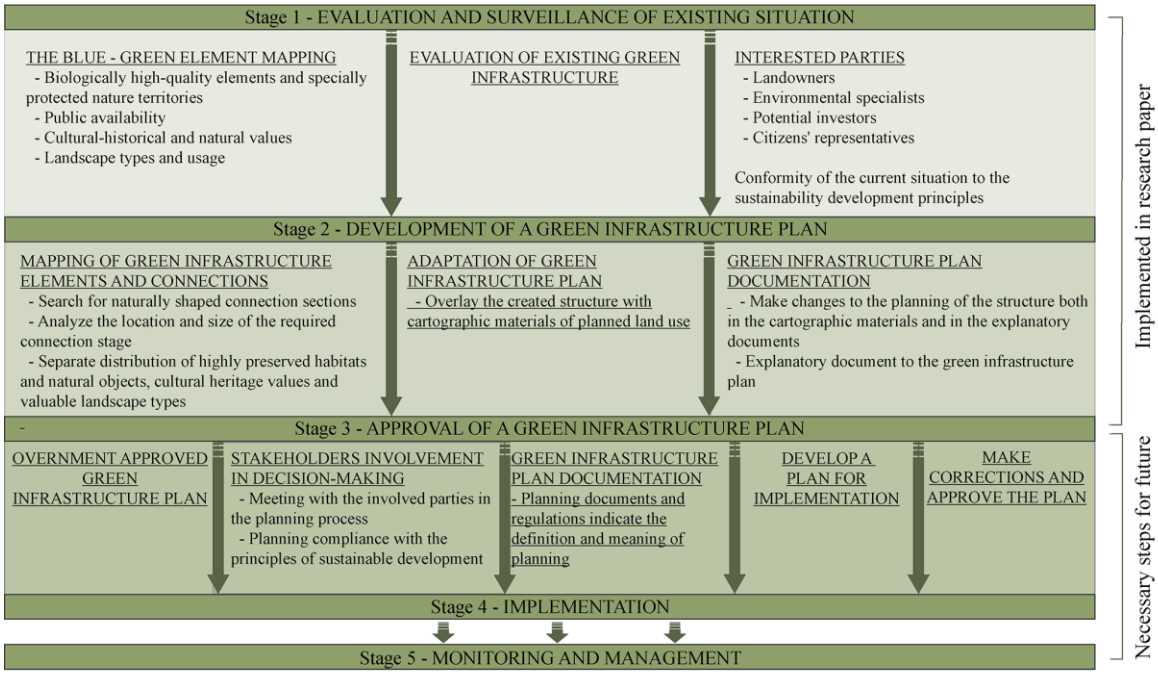

Fig. 3. GI planning, implementation and monitoring steps [created by authors]

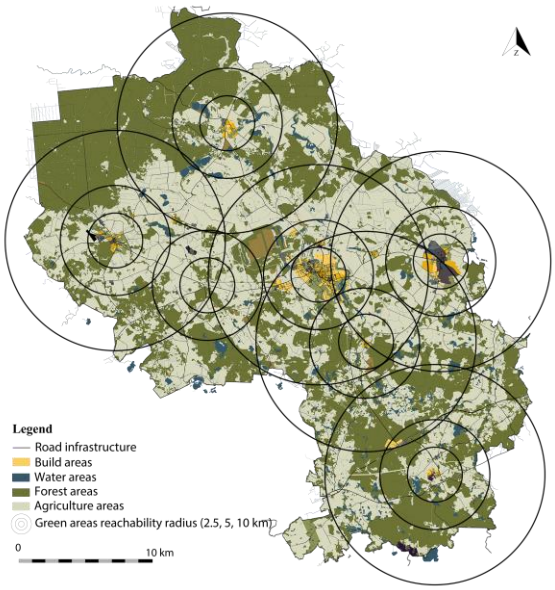

Fig. 4. Public access scheme of the existing GI [created by authors]

thus it is clearly visible in which areas the elements of GI are sufficient and where they are lacking, as well as the elements of darker colour, are more important for society, which should be taken into account in the further planning process. Yellow-coloured areas lack green structures, darker-coloured areas where public access would be high.

In the GI planning process, taking into account all previously mapped data, it is possible to determine the locations of potential and existing connections or green structures. Initially, the working group evaluates the existing situation, expressing possible improvements or recommendations. Further, various interested groups are involved in the evaluation process. Depending on the local context, interested parties may be representatives of relevant research agencies, local developers, landowners, etc. Together, already at the initial stage of planning, goals for the existing and potential GI should be set, in which direction it should develop, maybe there are special areas – highly attractive, evoking sentimental memories for residents, places of important events or business promotion (for example, in the field of rural tourism). The second stage of planning includes the mapping of connections and elements of GI, adaptation of the plan to the existing planning of the territories and preparation of documentation. The map of existing GI elements created in the first stage serves as a basis for the further planning process. Places where connections between important natural areas are missing are also clearly visible. The first task is to look for already naturally formed connection sections – river corridors, forest strips, etc. Naturally formed or preserved sections must be preserved. If necessary, corridor expansion can also be planned. It should be taken into account that administrative borders cannot exist in the planning of GI, there are none in nature, therefore attention must be paid to the influence of adjacent elements on the interior of the district and vice versa. Protected biotopes, natural objects, cultural and historical values and valuable types of landscapes should be pointed out in particular. As far as possible, the connection stages should try to include all the above elements. The initial planning process is carried out without the existing territorial planning map, in order to be based on the needs and benefits of nature and people. Only then

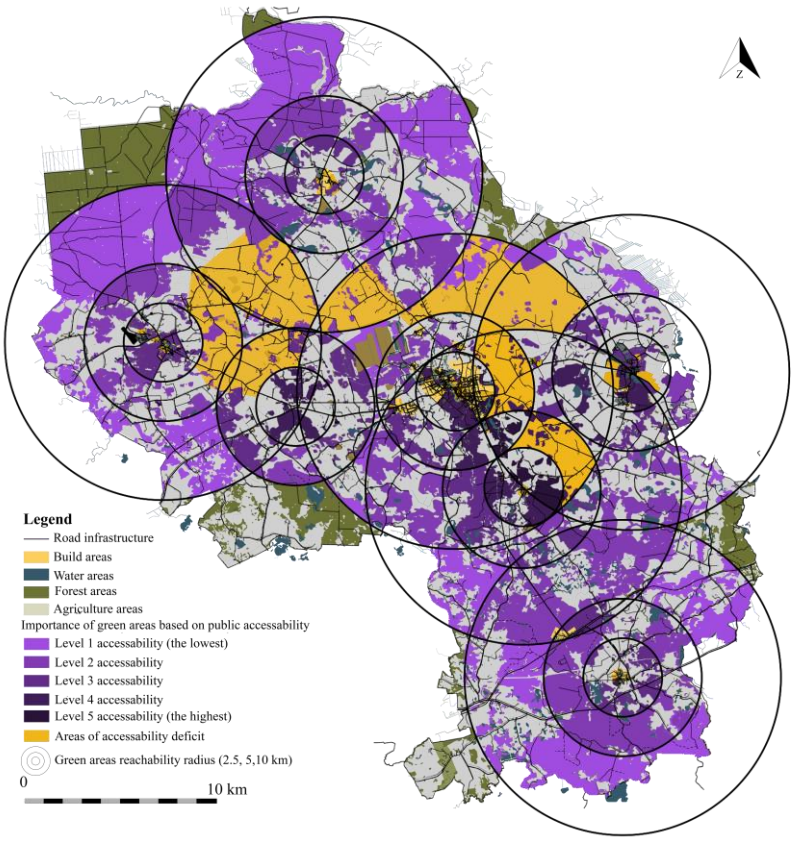

Fig. 5. GI deficit zones based on public accessibility [created by authors]

it is coordinated with existing planning documents in order to identify conflict zones. For example, where a potential natural area overlaps with an industrial area. At the end, the plan is clarified, trying to find compromises so that the development of the county is not disturbed, but the interests of nature and people in relation to the natural living environment are protected, as well as documentation for the implementation of GI is created. An explanatory document that answers the questions why such a structure is necessary, what it benefits and what actions should be taken to implement the structure in life.

In the third stage of the planning process, the GI is discussed, corrections are made and the plan is approved. During the consultation process, a decision is made on the amendments to the GI plan and the final plan is approved. The next section in the planning process is the inclusion of the green structure in the planning documents, fixing the goals, definition and meaning of the structure. In the next section, a structure implementation plan is developed, which clearly, step by step, indicates the actions to be taken.

The fourth and fifth stages are implementation, management and monitoring. It is possible to implement GI immediately or in parts. The implementation plan should evaluate the possible stages of implementation. It is necessary to manage the created and existing territories, of course, the municipality does this only on lands owned by the municipality. If the land belongs to the private owner, then already during the planning process, a support mechanism (tax incentives, etc.) must be introduced, which ensures that the private landowner will also be interested in maintaining the structure. As the last stage, there is monitoring to control the state of existing and created connections, elements and to control the processes taking place in them. Monitoring measures should be carried out regularly in order to be able to detect changes in nature in time, if they occur, and react accordingly.

Results and Discussion

As a results section, the developed GI planning approach is examined in the case study of the Aizpute town, nearby villages and rural areas.

A basic map was initially created at the county level, which includes forest, water and agricultural areas, as well as road infrastructure. Analyzing the spatial structure, it was clearly visible that there was a lack of connecting sections of GI in the district directly in the central part and around the largest settlements, which could ensure not only ecological, but also tourism and recreation linkages and more active use of rural areas for recreation and activities in nature. Such an approach is also emphasized as positive in the experience of creating a GI in England [17].

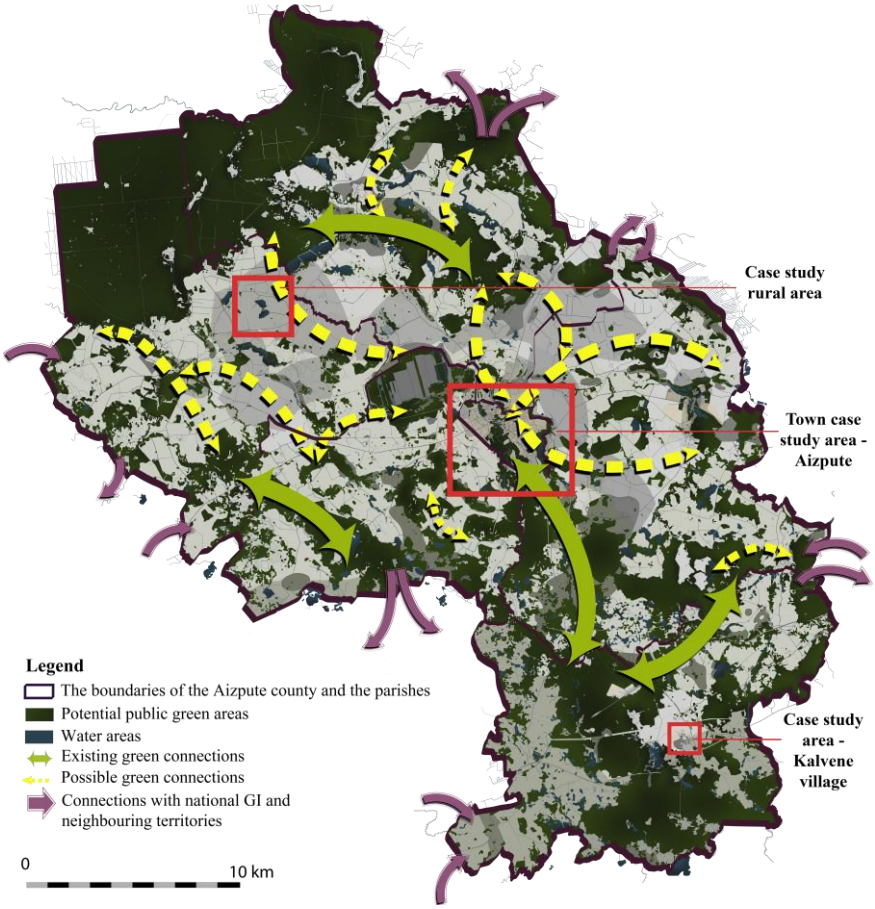

Fig. 6. Existing and potential green elements and connections of the case study area [created by authors]

The next step involved analyzing the location of biologically valuable elements and specially protected natural areas. The map depicted protected landscape areas, specially protected natural areas, cultural heritage objects, as well as recreation and tourism areas. Cultural and historical objects are mostly concentrated both in Aizpute and in villages and centres of settlements. The list of cultural and historical objects also includes various mounds and cemeteries, which are already part of the green structure. Therefore, it is possible to link the GI together with the education, recreation and tourism network.

A land use type scheme was also used, which represented the distribution of the landscape – forest, built-up, agricultural, water and mosaic landscape. The territory is dominated by forest and mosaic landscapes. However, in the northeast, there are large areas with agricultural lands, which would potentially need to be divided into smaller areas, so as not to form continuous agricultural lands, which contributes to the fragmentation of natural structures and the uniformity of the landscape. An example of the creation of a public accessibility scheme based on the example of the Aizpute district is discussed in the methods section. Accordingly, it can be concluded that there is a pronounced deficit of green structures in the northeastern, eastern and northwestern parts of the county. It can be seen that the deficit areas are exactly where there are large agricultural areas without blue-green elements or connections, see Figure 6.

Combining all previously obtained and analyzed data, in general, there are many blue-green elements and natural areas in the area around Aizpute, but for the full functioning of the GI, there is a lack of connection stages that would ensure ecological connection and improve the visual aesthetic and functional quality of the landscape.

After the evaluation of the existing situation and the involvement of the public, it is possible to start creating GI planning options, to look for the best solution for nature, society and other factors. Initially, it is possible to mark on the map already existing and easy-to-read connection sections, river corridors with a green structure, connections of forest sections, etc. Carefully evaluate whether the existing structure in the relevant place is sufficient and it is possible to ensure all the necessary processes. In the next step, the areas where the structure of the connection is inferred but not complete were marked. The areas are partially connected, but small discontinuities can be observed.

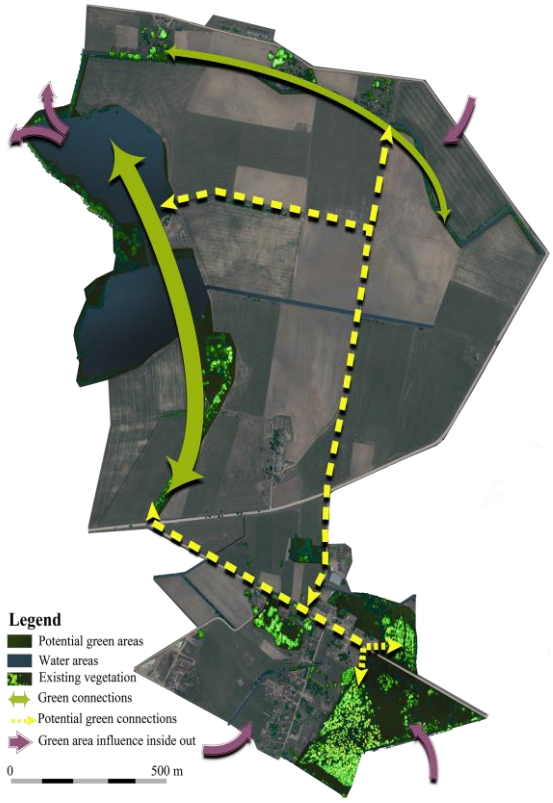

Fig. 7. Existing green elements and potential connections of rural areas [created by authors using kartes.lgia.gov.lv/]

After identifying the existing or partially existing connections, potential places for connecting were marked on the map - river corridors, points of the interconnection of cultural-historical, protected or biologically valuable territories, etc. In the GI planning process, the new corridors and connections were designed in such a way that they also include the existing small natural areas, as well as cultural heritage sites, forming a unified system. When planning the locations of potential structural connections, the areas of accessibility deficits analyzed above must be taken into account. Such a schematic approach allows for a clear assessment of whether it is possible to reduce the accessibility deficit by developing a new green structure, possibly by using already existing natural elements. In the situation of the Aizpute area, there are rivers in the accessibility deficit areas, which can be turned into GI connecting sections.

In the territory of the county and rural areas, there are four major possible types of green structure connections, which differ drastically in scale and detail from those required in a city or village. Mainly, on the county scale, the connections are formed by forest areas, separate clumps of woody plants or strips in agricultural lands, banks of watercourses, roadside greenery, for example, alleys. For forest areas, the forest edge is essential, which improves the biological and structural diversity of the landscape.

At present, in various regions of Latvia, in large areas, continuous areas of agricultural land can be observed, without connections of green structures. It should be carefully evaluated so that the connecting elements of the green structure do not overburden the agricultural activity, but at the same time are able to ensure the ecological connection. Corridors of this type (including small rivers or other watercourses) also ensure the preservation of the mosaic landscape. If there are watercourses between agricultural lands, then it is necessary to evaluate whether the type of land treatment (use of herbicides and pesticides) does not cause pollution to the ecological processes of the watercourse. If such a problem is detected, then the green protective zone around the water body should be increased.

River corridors are one of the most important connecting elements of GI. The river as a linear object connects different territories and crosses different landscapes. The ecological processes of the river often depend on the green areas next to it, so it is necessary to carefully evaluate the nature of the river and accordingly mark the places where the proximity of the green area is positive and where it is negative. The existence of green areas on the banks of the river creates a variety of new habitats and contributes to an overall increase in biodiversity.

Another important structural connection element is the road corridor and roadside greenery. The road splits different landscapes, but careful planning of GI can mitigate the splitting process. When evaluating the transition zones of green connections, the road can be part of a green corridor, or by bringing the green area closer to the road, it is possible to reduce the negative impact of the road. Safety aspects should also be evaluated because animal migration increases in places where green areas are close to the road surface, so warning signs or speed limits should be placed. Today, there are various solutions for road crossings with green bridges, tunnels, etc., but such solutions require high costs and in the conditions of Latvia, with not so intense traffic, it is possible to improve the situation only with high-quality planning of green and blue structures.

Scale of individual landscape areas. The planning of the GI of rural areas differs from the planning of the county only in terms of detail, because in the planning of rural areas, the greatest attention is focused on the creation or connection of local elements. GI planning in rural areas is most often associated with the fragmentation of green structures created by large areas of agricultural land and the need to create local ecological connections. In the selected example in Figure 7, the green structure has already formed naturally, but the direct connections are missing. There are two large ponds in the west of the area, with a tendency to swamp.

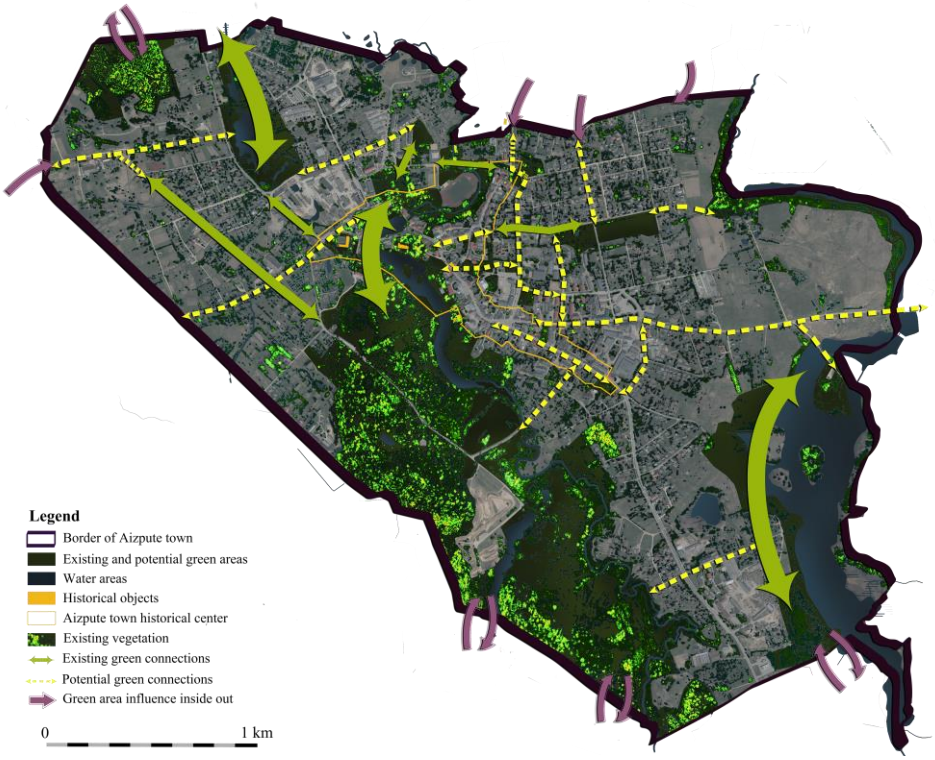

Fig. 8. Existing and potential green elements and connections in the Aizpute town [created by authors using kartes.lgia.gov.lv/]

Fig. 9. Existing and potential green elements and connections in the Kalvene village [created by authors using kartes.lgia.gov.lv/]

The outer northern boundary is closed by a small watercourse. Green areas are located in the south of the territory near a small settlement, as well as a small, narrow strip from the road to the ponds. In the central part of the territory, there is a pronounced deficit of green connections. In order to ensure the ecological connection and the connectivity of the settlement with the water course, the green corridor was created.

The planning of the GI of the Aizpute town is clearly necessary for the central part of the town. The beginnings of the Aizpute town can be traced back to the 13th century, so the central part of the town is densely built and with narrow street corridors. In the territory of the Aizpute town, the largest green element is the Misiņkalna Nature Park and the adjacent green areas, see Figure 8, the large blue elements are the Tebra river, Dzirnavu pond, the Lažas river and the Lažas reservoir.

The planning of green structures and connections is designed to interconnect the small green areas in the town centre with the vast areas of rivers, parks and forests outside the central part. The green areas in the town centre are not suitable for undisturbed recreation or they lack adequate amenities. All existing and potential green areas, which are interconnected, are marked in the plan. Since the historical centre of the Aizpute town is a state-protected monument of urban construction, the connections of the green structure were directed to or through the boundaries of the historical centre in order to integrate the cultural and historical

objects into the GI. Possible connections are also planned with elements outside the town limits, such as areas of orchards.

The territory of the Kalvene village, which is clearly divided by areas of agricultural land, was selected for the planning of the GI of the village. In the south and north of the village, there are wider green areas, which are complemented by small water features, see Figure 9.

When planning the GI, a connection was conceptually created in the immediate vicinity of the currently actively used pedestrian path, in order to provide a pleasant and visually attractive route and create an ecological connection with the village centre. All connecting elements can be detailed according to the environmental conditions (appropriate plant species, materials), as well as the nature of the specific place (place identity, visual image, history) and set needs (tourism, daily environmental quality improvements, etc.). Such planning principles are also widely discussed in the creation of the GI of Scandinavian villages, additionally emphasizing the integration of sustainable management of rainwater into the GI [29].

Conclusions

Analyzing the planning documents of different European countries, it can be concluded that each planning scale requires a different approach and planning mechanisms, as well as the detailing of solutions.

For the introduction of GI at the level of the state, regions, counties and cities of the republic, it would be necessary to make changes in the regulatory documents of Latvia. In order to create a full-fledged structure at the national level, it would be necessary to develop additional regulatory documents that regulate and determine the exact tasks for the implementation of GI - general guidelines on the importance of the structure's implementation, positive aspects and benefits for society.

Also, at the national level, a conceptual plan should be developed, a map depicting the elements forming the GI of national importance.

At the regional level, the planning documents already contain more detailed information about the elements and connections of the GI, as well as additional indications on the development of the planning process at lower levels. A more detailed mapping of the elements and connections of the green structure should be carried out in the planning, including biologically valuable territories, specially protected natural territories or aesthetically and culturally significant landscapes. Mapping and planning should be done from a regional point of view, without going into too much detail.

At the county planning level, the documentation expresses detailed proposals and recommendations as to how it is necessary to plan more detailed structures. The plan includes maps with all GI elements and connections marked in detail. The planning document also includes more detail about cities, villages and settlements. On the city scale, such planning can also be a greening concept, including both larger blue and green areas, and planning already very small parks or green areas. The planning, from the side of the regulatory framework, should define what should be included in the GI planning and what actions are intended to maintain the structure in its current state and improve it.

Researching the Aizpute town and its nearby villages and rural areas concluded that there are many blue and green elements in it, but there are connections missing. The methodology was conceptually applied to the area around Aizpute, marking the existing and possible locations of connection corridors, as well as evaluating the influence of the elements in the adjacent areas on the inside and vice versa.

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Kopsavilkums. Vēl nesen zaļā infrastruktūra (ZI) bija tikai pievienotā vērtība nekustamajam īpašumam, taču šodien tai ir pavisam cita, daudz svarīgāka loma. Raksts definē galvenos principus ZI plānošanā Latvijā, izmantojot trīs līmeņu pieeju. Katrs līmenis atbilst noteiktam teritorijas mērogam, sākot ar reģionālo mērogu, pārejot uz lauku un urbanizētām teritorijām un beidzot ar vietas mērogu. Katrs zemākais līmenis ir pakārtots augstākajam, tādējādi veidojot vienotu ZI plānošanas sistēmu. Kā izpētes teritorija rakstam izvēlēta Aizpute, tai blakus esošie ciemi un lauku apvidi.