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THE IMPACT OF RURAL DEVELOPMENT LAND MANAGEMENT PROJECTS ON THE SUSTAINABLE DEVELOPMENT OF PROTECTED AREAS: CASE STUDY OF THE NEMUNAS LOOPS REGIONAL PARK

Ingrida IGNATAVIČIENĖ, Department of Land Use Planning and Geomatics, Faculty of Engineering, Vytautas Magnus University, K. Donelaičio g. 58, 44248 Kaunas, Lithuania, ingrida.iene@gmail.com
Virginija GURSKIENĖ, Department of Land Use Planning and Geomatics, Faculty of Engineering, Vytautas Magnus University, K. Donelaičio g. 58, 44248 Kaunas, Lithuania, virginija.gurskiene@vdu.lt *(corresponding author)*
Vida MALIENE, Department of Land Use Planning and Geomatics, Faculty of Engineering, Vytautas Magnus University, K. Donelaičio g. 58, 44248 Kaunas, Lithuania, vida.maliene@vdu.lt
Iryna KOSHKALDA, Department of Land Management and Cadastre, Faculty of forestry, wood-processing technologies and land organisation, State Biotechnological University, Alchevskykh St. 44, Kharkiv, 61002, Ukraine, irinavit1506@gmail.com

Over the last few years, a lot of attention has been given to preserving natural and cultural heritage. In Lithuania, the amount of land designated as protected areas has grown significantly. A major challenge is learning to live in harmony with nature meeting the needs of society without causing harm. It's crucial to strike a balance between preserving valuable landscapes, biodiversity, and both natural and cultural heritage, and allowing for urban development, economic activities, and other human impacts.
Spatial planning documents aim to create a harmonious relationship between the natural and human-made environments. The aim of research is to evaluate the effectiveness of the Rural Development Land Management Projects, prepared between 2012 and 2024, and their impact on sustainable development within the Nemunas Loops Regional Park. This park spans the municipalities of Alytus district, Birštonas and Prienai district. Also, the analysis of issued planning permits in the park territory, based on Management Plan, is made.
The research shows that both the Rural Development Land Management Projects and issued planning permits within the protected area align with the park's Management Plan. This plan effectively balances human activity by regulating urban development, particularly in sensitive protected zones. By examining issued planning permits from the municipalities of Alytus district, Birštonas and Prienai district, we found that new urban development within the Nemunas Loops Regional Park is guided by the Management Plan. The plan's regulations are key instrument to control urban development in the area.

Keywords: *protected areas, Rural Development Land Management Projects, sustainable development*

INTRODUCTION

In Lithuania, the area of protected land is growing, and with it, the influence of human activity on these protected landscapes. The analysis of this human impact is a relevant topic because these processes directly affect the natural environment, the preservation of landscape and cultural heritage, and the assurance of environmental sustainability. This human influence can have both positive and negative consequences for protected areas (Gomes et al., 2021; Jasinavičiūtė, 2023). Protected areas are often established to conserve specific ecosystems, rare plant and animal species, valuable landscapes, and cultural heritage (Baškytė & Obelevičius,2023; Gurskiene et al., 2024; Kavaliauskas, 2006; Valantiejūtė, 2024). According to Lithuanian law, protected areas are defined as land and/or water areas with clear boundaries that have recognized scientific, ecological, or cultural value. A special regime for their protection and use is established by legal acts (Lietuvos…, 2001). The system of protected areas should reflect the full diversity of the country's landscape (Benayas, Bullock, 2012; Jasinavičiūtė, 2023).

Many authors emphasize the importance of protected areas, highlighting their global and regional significance and the necessity of their preservation (Caro-Borrero et al., 2021; Gizachew, 2020; Mann, 2018). The goal is to ensure sustainable development by expanding the network of protected areas without causing harm to the natural environment through human impact. Legal regulations and spatial planning are designed to ensure a sustainable relationship between the natural and human-made environments.

Human activities can threaten the conservation of natural values by destroying habitats, key natural areas, and causing other negative impacts (Bražiūnas et al., 2024; Gurskiene et al., 2024; Savickaitė, Jasinavičiūtė, 2023;

Sujetovienė, Dabašinskas, 2023). To maintain the ecological balance and stability of protected areas, it is necessary to promote and implement an environmentally friendly model of urbanization and limit harmful human activities.

These activities within protected areas require clear legal regulation that balances development and protection. This includes a system of spatial planning, construction regulations, and other legal mechanisms. Ultimately, human activities in protected areas demand a balanced approach and responsible planning to ensure that natural and cultural values are preserved while local communities benefit from sustainable development (Baškytė & Obelevičius, 2023; Kavaliauskas, 2006; Valantiejūtė, 2024).

Land management planning documents are a crucial part of the overall territorial planning system. The specific documents analyzed, Rural Development Land Management Projects, are local-level land management plans for rural areas in Lithuania. They are created to comprehensively plan for land use change, including forest planting and other agricultural activities. These projects also help to form land holdings for agricultural and other businesses in non-urbanized and non-urbanizable rural areas (Lietuvos..., 2004).

These are specific projects focused on managing Lithuania's rural territories. Several authors (Aleknavičius et al., 2016; Gurskienė et al., 2023; Klimovaitė, 2018) have analyzed these projects in the context of reorganizing farm land holdings, emphasizing their importance for the rational use of agricultural land and effective farm management. However, these previous studies did not assess the potential for urban development.

This study analyzes the solutions of Rural Development Land Management Projects prepared between 2012 and 2024 in three Lithuanian municipalities. The focus is on projects that designate locations for a farmer's homestead and/or other agricultural buildings. Very few studies of this kind have been conducted in Lithuania (Praškevičienė, 2018), and the existing ones have not examined the impact of these projects on the sustainable development of protected areas.

The aim of the research is to assess the impact of Rural Development Land Management Projects on the sustainable development of the Nemunas Loops Regional Park.

To achieve the aim, the following objectives are set up as follows:

1. Assess population changes in the analyzed areas.
2. Evaluate the main indicators of farmers' holdings.
3. Analyze Rural Development Land Management Projects and issued planning permit documents in the selected areas.

RESEARCH METHODS

The subject of this research is the Nemunas Loops Regional Park and the municipalities it covers: Alytus district, Birštonas and Prienai district. We will also be analyzing the park's Rural Development Land Management Projects.

In Lithuania, many protected areas, including regional parks, lack clear territorial or administrative boundaries. Instead, their boundaries are defined by natural, cultural, and recreational features such as landscape complexes and ecosystems.

The Nemunas Loops Regional Park covers an area of 25,079.76 hectares (see Figure 1). Its territory is located within four municipalities: Alytus district (3,901.67 ha), Birštonas (9,993.22 ha), Prienai district (11,184.50 ha), and a small portion in Kaišiadorys district (0.38 ha) (Saugomų..., 2024).

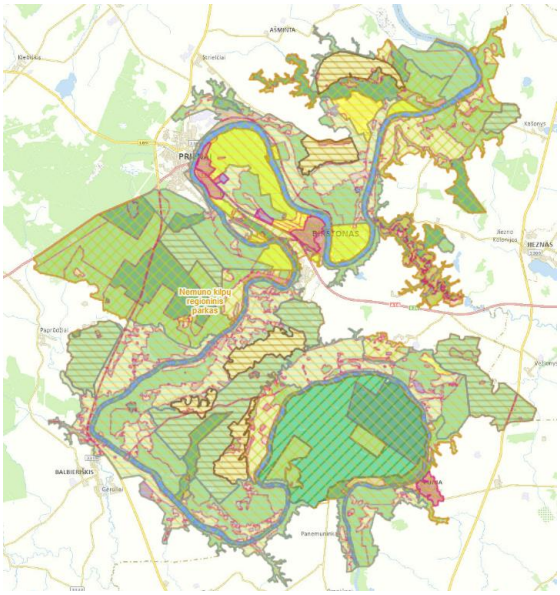


Figure 1. Nemunas Loops Regional Park (State Cadastre of Protected Areas of the Republic of Lithuania data)

We assessed the situation both within the park and in the surrounding areas that impact it by analyzing three municipalities: Alytus district, Birštonas and Prienai district. These municipalities collectively contain the vast majority (99%) of the Nemunas Loops Regional Park's territory (Table 1).

Table 1. Indicators for the analyzed municipalities as of January 1, 2024 (Source: Oficialiosios..., 2024; [1]Saugomų..., 2024)

Indicators	Municipalities		
	Alytus district	**Birštonas**	**Prienai district**
Total area, hectares	140340	12172	103253
Population density, inhabitants/sq. km	18.1	33.8	23.9
Permanent city residents, total number of individuals	2094	3010	9775
Percentage of the total population number	8.2	73.6	39.6
Permanent village residents, number of individuals	23370	1079	14899

The Prienai district municipality contains the largest portion (44.6%) of the Nemunas Loops Regional Park. Although the park's share in the Birštonas municipality isn't the largest overall, it occupies a significant 82.1% of the municipality's total area. Of the municipalities studied, Birštonas city is the most densely populated, with approximately 34 inhabitants per square kilometer, while Alytus district municipality has the lowest density at 18.1. Birštonas municipality also has the highest percentage of urban residents (73.6%), whereas Alytus district municipality has the highest percentage of rural residents (91.8%).

This research assess the impact of human activity on the protected landscapes of the Nemunas Loops Regional Park. A key factor in this assessment is population and how it changes over time. We analyzed the change in the number of permanent residents in Alytus district, Birštonas, and Prienai district municipalities from 2012 to 2024, using data from the Official Statistics Portal (2024).

The concepts of "human activity" and "urbanization" are closely linked to "built-up area," which is also a focus of this research. A built-up area is land occupied by structures (excluding roads), as well as land used for the direct operation of these structures, such as squares, stadiums, and industrial plots (Lietuvos..., 2012-2024). Like other land uses, these areas change in both urban and rural environments. In rural areas, these changes are influenced by land management planning documents, making it essential to analyze their impact. To understand where urbanisation is taking place, we analyzed issued planning permit documents to assess planned buildings within the protected areas.

We analyzed the solutions outlined in Rural Development Land Management Projects for establishing a farmer's homestead and/or other necessary agricultural buildings. Data on registered projects from 2012-2024 and permits for new one- and two-family buildings from 2015-2024 were collected and analyzed from the Territorial Planning and Construction Gateway (www.planojuostatau.lt). The analysis covered Alytus district, Birštonas, and Prienai district municipalities, focusing on the specific wards that include the Nemunas Loops Regional Park.

Since these projects are limited to registered farmers, we also used data from the State Enterprise Agricultural Information and Rural Business Center (2012-2024) to analyze key farm indicators. This allowed us to determine the average farm size, total land area, and the dominant land uses on farms, as well as calculate and analyze changes in these indicators across the municipalities.

Our analysis included 16 Rural Development Land Management Projects and 112 planning permit documents for objects located within the Nemunas Loops Regional Park. We examined changes in built-up areas and other land use types, and we also analyzed and evaluated the connections between the park's Management Plan and the solutions presented in the land management projects and planning permits.

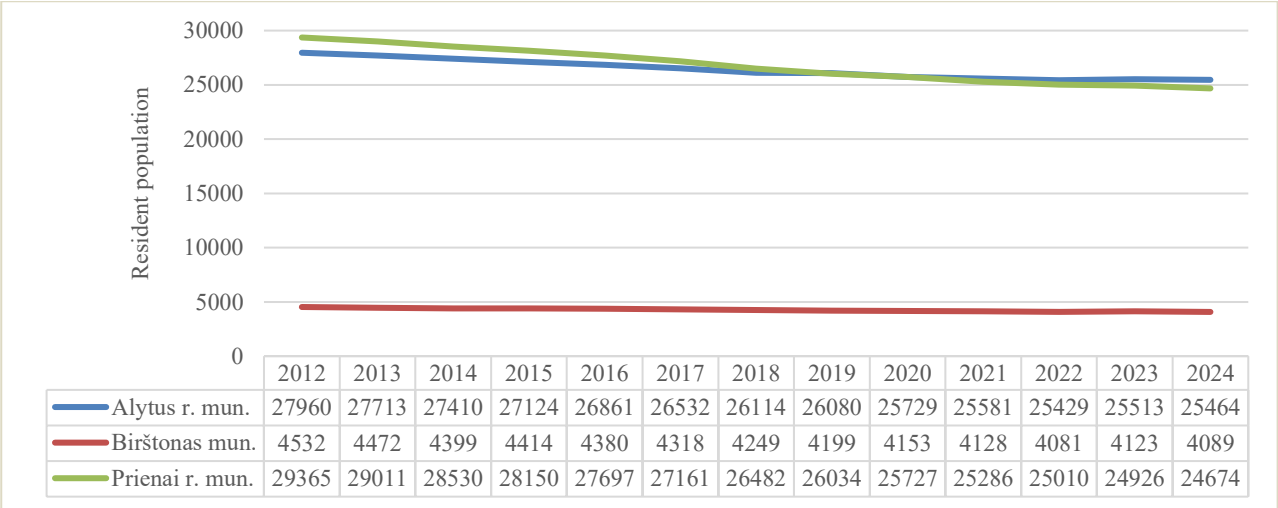
The data for this research was compiled from the following secondary datasets:

- National Land Service under the Ministry of Environment (Nacionalinė žemės..., 2024),
- National Land Service under the Ministry of Agriculture (Nacionalinė žemės..., 2012-2023),
- National Paying Agency under the Ministry of Agriculture (Nacionalinė mokėjimo…, 2024),
- Official Statistics Portal (Oficialiosios…, 2025),
- State Cadastre of Protected Areas (Saugomų…, 2024),
- Territorial Planning and Construction Gateway (Teritorijų…, 2025),
- State Enterprise Agricultural Information and Rural Business Centre (Valstybės įmonės…, 2025),
- Land Resources Monitoring Information System (www.zisis.lt) (Žemės apskaita, 2020-2024).

By conduction the study analysis, we applied following research methods: logical data analysis, recursive abstraction, comparison, generalization and statistical analysis.

RESEARCH RESULTS AND DISCUSSION

There are several factors that influence landscape change. One of the primary factors for assessing the impact of human activity on protected landscapes is the resident population and how it changes over time. To evaluate this impact, we determined the change in permanent population from 2012 to 2024 in the Alytus district, Birštonas and Prienai district municipalities (Figure 2).

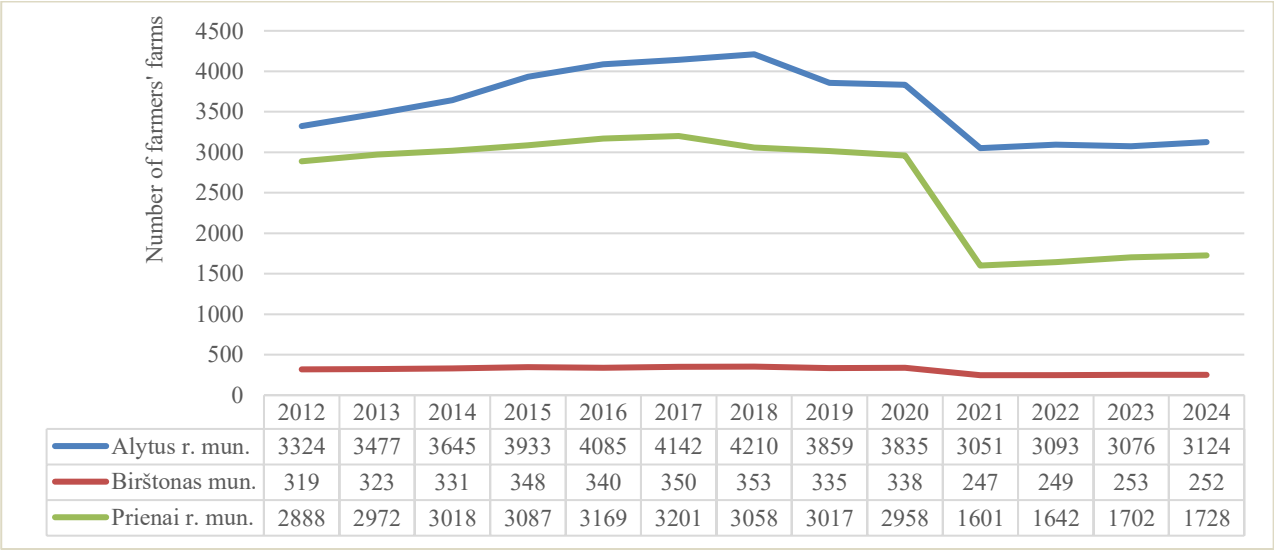


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Alytus r. mun.	27960	27713	27410	27124	26861	26532	26114	26080	25729	25581	25429	25513	25464
Birštonas mun.	4532	4472	4399	4414	4380	4318	4249	4199	4153	4128	4081	4123	4089
Prienai r. mun.	29365	29011	28530	28150	27697	27161	26482	26034	25727	25286	25010	24926	24674

Figure 2. Number of permanent residents in municipalities in 2012–2024 (at the beginning of the year) (compiled by the authors based on Oficialiosios..., 2025)

In the municipalities analyzed, a trend of population decline is evident. The most significant decrease in permanent residents occurred in the Prienai district municipality, although the rate of decline has started to slow since 2021. While the Prienai district had a higher permanent population than the Alytus district in 2012, this trend reversed in 2019, when the Alytus district's population surpassed that of the Prienai district. The number of permanent residents in the Birštonas municipality is also decreasing. Changes to the landscape are also an important consideration. When new structures are planned and built, the built-up area increases, directly altering the landscape.

The Rural Development Land Management Projects analyzed in this research are initiated by individuals who farm in rural areas. Only registered farmers are eligible to apply for these projects when planning to build new structures. To determine the demand for these projects, it is relevant to analyze the number of farms and how this number is changing in the analyzed municipalities (Figure 3). The need for more built-up areas and the resulting landscape changes are directly tied to the number of active farmers.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Alytus r. mun.	3324	3477	3645	3933	4085	4142	4210	3859	3835	3051	3093	3076	3124
Birštonas mun.	319	323	331	348	340	350	353	335	338	247	249	253	252
Prienai r. mun.	2888	2972	3018	3087	3169	3201	3058	3017	2958	1601	1642	1702	1728

Figure 3. Number of farmers‘ farms in Alytus district municipality, Birštonas municipality and Prienai district municipality in 2012–2024 (compiled by the authors according to the Valstybės..., 2025)

An analysis of farmers’ farms in the three municipalities reveals a decrease in the number of farmers during the study period: a 6% decrease in Alytus district, 21% in Birštonas, and 40% in Prienai district. The sharpest decline since 2019 is likely due to an amendment to the Law on Farmers’ Farm. This law, effective since 2018, requires farmers to update their information in the Farmers’ Farms Register annually by December 31, even if the data remains unchanged.

Furthermore, it is important to analyze not only the number of farms but also their average size, the total land area they use, and the dominant land uses within those farms (Table 2).

Our analysis shows that a municipality's total area directly correlates with the number of farms it contains. However, according to our research results, the number of farms is decreasing across all municipalities. The most significant decrease was in Prienai district municipality, which was 40% reduction over a 12-month period.

Table 2. Data on farms registered in Alytus district, Birštonas, Prienai district municipalities (compiled by the authors according to the Valstybės..., 2025)

Municipality	**Year**[1]	**Number of Farmers' farms**	Total land plot, in hectare	**Average farmers' farms size, in hectare**	**Registered area by land use distribution, in hectare**			
					Agricultural land	Forest land	Wetland	Other land use
Alytus district	2012	3324	26380.3	7.94	22006.74	2124.98	328.52	1594.49
	2024	3124	33993.21	10.88	28739.68	2331.53	412.95	2056.11
Birštonas	2012	319	1676.06	5.25	1259.15	294.3	18.13	69.82
	2024	252	1628.99	6.46	1331.19	187.34	11.38	64.11
Prienai district	2012	2888	21173.47	7.33	18294.16	1466.68	232.19	856.4
	2024	1728	16301.86	9.43	14326.36	771.86	182.55	768.39

Note: [1] – at the beginning of the year

In 2024, Alytus district municipality had the largest average farm size at 10.88 hectares, while Birštonas municipality had the smallest at 6.46 hectares. Of the three municipalities, Alytus district municipality experienced the greatest growth in the total land area used by farms.

Although the number of farms is declining, however the average farm land size is growing. Agricultural land makes up the majority of this area, accounting for about 84% of the total. During the research period, agricultural land increased by approximately 5.5%. Prienai district municipality was an exception to this trend, showing a significant decrease of over 20% in the total area of its farms.

Farmers require buildings, such as homesteads and auxiliary structures, to conduct their activities. Rural Development Land Management Projects can be used to plan the location of these buildings. Our analysis of these projects, registered in the municipalities from 2012 to 2024, helps us understand the demand for homesteads, auxiliary farms, and other structures necessary for farming, such as greenhouses and rural tourism facilities (Table 3).

Table 3. Number of registered Rural Development Land Management Projects in Alytus district, Birštonas and Prienai district municipalities in 2012-2024 (compiled by the authors according to Teritorijų..., 2025)

Year	**Municipality**					
	Alytus district		**Birštonas**		**Prienai district**	
	number	in percentage	number	in percentage	number	in percentage
2012	0	0	0	0	26	13
2013	16	5	1	4	20	11
2014	34	10	2	9	10	5
2015	48	15	4	17	27*	14
2016	37	11	5	22	17*	9
2017	39	12	1	4	13*	7
2018	43	13	2	9	8	4
2019	34	10	2	9	15	8
2020	22	7	1	4	7	4
2021	19	6	0	0	11	6
2022	8	2	1	4	10	5
2023	25	8	4	17	27	14
2024	4	1	0	0	2	1
Total	329	100	23	100	193	100

Note:* - revised data from the Land Management Planning Documents Preparation Information System www.zpdris.lt

After collecting and analyzing the data, we found that the largest number of Rural Development Land Management Projects was registered in the Alytus district municipality (329), while the smallest number was in the Birštonas municipality (only 23). The volume of these projects peaked in both 2015 and 2023 across all municipalities.

Since this research focuses on the impact of human activity on the Nemunas Loops Regional Park's landscape, we calculated how many of these projects were prepared specifically within its territory (Table 4).

Table 4. Rural Development Land Management Projects registered in 2012-2024, which fall within the territory of the Nemunas Loops Regional Park (compiled by the authors based on Teritorijų..., 2025)

Multicipalities	**Wards**	**Rural Development Land Management Projects**		
		Total	In the territory of the Nemunas Loops Regional Park	In percentage
Alytus district	Alytus	35	0	0
	Punia	19	0	0
Birštonas	Birštonas	23	9	39
Prienai district	Balbieriškis	22	3	14
	Jieznas	22	0	0
	Prienai	6	4	67
	Pakuonis	0	0	0

The Nemunas Loops Regional Park's territory is located in seven different municipal wards, but the Rural Development Land Management projects were prepared in only three of them. Of these, Prienai ward accounted for a significant 67 percent of the projects prepared for the protected area, while Birštonas ward accounted for 39 percent.

To better understand where new urban development is planned, we analyzed the location of the proposed built-up areas within the park's territory, specifically determining which zones of the Management Plan are being targeted for development (Figure 4).

a **b**

Figure 4. Segments of the Rural Development Land Management Project (a) and the Management Plan Solution (b) (symbols: a - building area, b - possible new homestead)

We identified which Rural Development Land Management projects were located within the specific landscape management zones outlined in the Management Plan to better understand how they align with the park's zoning. This analysis showed that the project locations correspond well with the designated development opportunities for built-up areas within the protected park.

We analyzed 16 of these projects, which included plans for new farmer's homesteads, auxiliary farms, and other agricultural buildings (such as farms, greenhouses, or rural tourism facilities). The goal was to determine how the built-up area would change while also considering the solutions provided in the Nemunas Loops Regional Park Management Plan (Table 5).

Table 5. Main data of rural development land management projects prepared for the territory of the Nemunas Loops Regional Park (compiled by the authors based on the solutions of the Teritorijų.., 2025 and the Management Plan)

Municipality	Years	Total area of land plot, hectare	Built-up area, hectare	Built-up area, percent of total area	Management Plan Solution/ Comment
Birštonas	2013	1.0059	0.2697	27	Old management plan (1997)
	2015	2.4499	0.8000	33	New homestead allowed for development
		5.0000	1.0000	20	New homestead allowed for development
	2016	0.7120	0.1822	26	New homestead allowed for development
		2.4174	0.4748	20	Agricultural functional priority zone, ŽAb/Existing homestead
	2017	4.0000	0.6405	16	functional priority zone, ŽAs/Existing homestead
	2019	0.7248	0.5770	80	Ecological protection functional priority zone, ŽAs/Existing homestead
	2020	0.5909	0.0771	13	New homestead allowed for development
	2023	3.3824	1.8726	55	Ecological protection functional priority zone, ŽAs/Existing homestead
Prienai district	2015	3.8326	0.4171	11	Ecological protection functional priority zone, ŽAs/Existing homestead
		16.4866	0.7000	4	Agricultural functional priority zone, ŽAb/Possible on agricultural land plots of 10 hectares or more
		1.6921	0.9156	54	Ecological protection functional priority zone, ŽAs/Existing homestead
	2016	0.6003	0.1705	28	New homestead allowed for development
	2017	1.0784	0.4847	45	New homestead allowed for development
	2018	4.1588	1.063	26	New homestead allowed for development
	2023	1.2322	0.2239	18	New homestead allowed for development

In Birštonas municipality, urban areas specified in the projects range from 0.0784 to 1.8726 hectares, while in Prienai district municipality, the range is 0.1705 to 1.0630 hectares. The average urban area is 29 percent of the total plot size in Birštonas and 14 percent in Prienai district. This discrepancy is mainly due to the wider range of total land plot sizes and a higher number of smaller plots in Birštonas.

Our analysis of Rural Development Land Management projects shows they significantly impact changes in built-up areas by creating new building plots, which alters land use.

Out of all the registered projects across the three municipalities, 16 were located within the Nemunas Loops Regional Park. This indicates that land use is more strictly regulated in protected areas, a measure effectively implemented through the park's Management Plans.

Despite a declining population, the demand for housing is increasing as residents seek more comfortable and spacious living conditions for both, recreation and work. This trend drives the need for new urbanisation.

We analyzed 112 planning permits issued within the Nemunas Loops Regional Park to see how they align with the park's Management Plan and to know where the development is taking place (Table 6).

Table 6. Distribution of the number of planning permits in the zones of the Nemunas Loops Regional Park Management Plan (compiled by the authors based on the solutions of the Teritorijų..., 2025 and Management Plan)

Municipality	Issued planning permits, number	Fnctional priority zone in Management Plan	Landscape management zone in Management Plan
Alytus district	1	Residential	GŪe
Birštonas	50	Residential	GŪe, NRu, NRu1
	18	Conservation	GEk, GEr, GAi
	10	Ecological protection	ŽAs, ŽRi, ŽAb
	2	Agricultural	ŽAb
	2	Recreational	MRe
Prienai district	8	Residential	GUe
	8	Conservation	GEr, ŽAs, MAs,
	11	Ecological protection	GAe, ŽAb, ŽAs
	2	Agricultural	ŽAb

Within the Nemunas Loops Regional Park, 61 percent of all planning permits were issued in the Residential Functional Priority Zone of the Birštonas municipality. In contrast, only one permit was issued in the Alytus district municipality (specifically, in the village of Punia). In the Prienai district municipality, 38 percent of permits within the park were for properties in the Ecological Protection Functional Priority Zone.

An analysis of the issued planning permits, based on the park's landscape management zoning, reveals that the projects align with the development guidelines for protected areas. The Management Plan effectively directs development and helps manage the expansion of built-up areas.

Our findings from Alytus district, Birštonas, and Prienai district municipalities show that new urban development within the park is regulated by the Management Plan. The plan provides clear direction and effectively controls the flow of urban development.

CONCLUSIONS

Demographic Trends and Sustainable Development: A population decline was observed across all municipalities during the analyzed period. The most significant decrease occurred in Prienai district, though the rate of decline has slowed since 2021. This stabilization in population can be a positive factor for sustainable development, as it allows for more effective planning of infrastructure, efficient resource use, and the creation of more sustainable residential areas.

Agricultural Trends and Biodiversity: While the number of farms in the analyzed municipalities decreased, the average farm size and agricultural land area increased. This consolidation can lead to greater economic efficiency and competitiveness but may negatively impact biodiversity. The prevalence of monocultures on large farms can reduce plant and animal diversity and increase the risk of soil erosion and pest outbreaks.

Land Management and Construction Regulation: The analysis of rural development land management projects and issued planning permits indicates that urban development within the protected area aligns with the Management Plan. This plan is effective in balancing human activity and regulating urban development flows, which is particularly crucial for all protected areas.

Limitations of Project Assessment: It is challenging to assess the comprehensive impact of these rural development projects on the natural environment, because they do not specify the planned economic activities. This limitation makes it difficult to fully evaluate their effect on sustainable development.

Therefore, when preparing Rural Development Land Management Projects in protected areas that provide for the possibility of building construction, it is recommended to assess the scope of economic activities carried out and the prospects for their change.

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