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TREES AND SHRUBS GREENERY AREA CHANGES IN VILNIUS AND KAUNAS COUNTIES

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The purpose of this study was to perform an analysis of the change in the trees and shrubs greenery area of Vilnius and Kaunas counties in 2002–2023. To prepare this article, the following scientific methods were used: statistical data, analytical, comparative and graphical representation analysis. The method of analytical, logical analysis was used to determine the reasons for the increase in the area of tree and shrubs greenery in Vilnius and Kaunas counties. To achieve the aim, a comparative method was used, which determined the change of tree and shrubs greenery areas in Vilnius and Kaunas counties and its municipalities in 2002–2023. The data of the Land Fund of the Republic of Lithuania for 21 years were used for comparative investigation. In 2023, tree and shrub plantations in Vilnius county covered 45,082.20 ha, accounting for 4.63 percent of the county's area, this is more than Lithuanian average (3.20 percent). Meanwhile, tree and shrub plantations in Kaunas county covered 21,728.15 ha or 2.69 percent. From the analysis, it can be seen that in all municipalities of Vilnius county, tree and shrub plantations exceeds the Lithuanian average, while in Kaunas county, only four municipalities (Birštonas, Kasiadorys, Kaunas, Prienai district) exceed the national average, in the rest of the municipalities trees and shrubs greenery do not reach 3.20 percent. From 2002 to 2023 the area of trees and shrubs greenery in Vilnius county increased by 23,384.21 ha or 107.77 percent. The area of greenery in Kaunas county increased by 10,444.56 ha or 92.56 percent during the period under review. In Vilnius and Kaunas counties and their municipalities, the area of trees and shrubs greenery increased due to the implemented projects and programs and the most important is the creation of legislative framework.

Keywords: *trees, shrubs, plantations, greenery.*

INTRODUCTION

The publication of Land Fund of the Republic of Lithuania (Nacionalinė..., 2022), contains a definition of tree and shrub plantations, i.e., separate plantations (parks, squares, green links) and areas of plantations (trees and shrubs) that are not classified as forests. Individual trees and shrubs, groups of trees and shrubs, rows of trees and shrubs are included in plantation areas when they form a contour of at least 0.1 ha.

Trees are woody plants. They constantly refresh its growing. Mostly trees have a single trunk, and mostly all species of trees the trunk grows branches (Weber, Everett, Berlyn, 2023). A tree is the tallest form of plant floral diversity that is woody, perennial, and branched among other plant varieties.

Shrubs are multi-stemmed short woody plants, more prevalent than trees. Shrubs are very significant in many ecosystems, abandoned in ecology compared to trees or other plants, but nowadays in focus due to their worldwide development (Goetmark, Goetmark, Jensen, 2016).

Growing trees and shrubs are so relevant that they are called the lungs of the planet, cleaning the air and performing other functions. The essential thing that makes up the ecosystem are trees and shrubs. They can parcel facilitate the chance of pollution in greeneries (Lohe et. al., 2015).

Plants, for example, trees and shrubs, are especially important for maintaining the function of the biosphere. Trees and shrubs grow in almost all countries of our planet. They are of various types, species, sizes, widths and etc. (Fernando, 2012).

Trees and shrubs in every environment supply a huge array of ecosystem services, increasing the well-being of people (Klobucar et. al., 2021).

Plants (trees and shrubs) in the environment have a lot of functions, they modulating the climate and microclimate, reducing air and noise pollution, providing a habitat for wildlife in addition to their aesthetic importance (Lin, Lin, 2010).

Author S. Ghafari and co-authors (2020), claim that sustainability in greenery means the adjustment of trees and shrubs to growth and climate situation, however, L. Supriya (2018) emphasize that due to global climate change and warming, trees and shrubs vegetate longer. In this case, trees and shrubs grow faster, but they are weaker.

Although there is a lot of discussion about the effects of climate change on plants, it should be noted that trees and shrubs perform many different functions in shaping the environment (Baluska, Mancuso, 2020).

Currently, it is recommended to allocate 9 sq. meters per person of greenery in cities. These areas must perform functionality, aesthetics, practicality, safety and other functions. It is also urged to increase the area of green spaces in cities to 50 sq. meters per person (Maryanti, Khadijah, Uzair, Megat Mohd Ghazali, 2016).

Worldwide, there are 5 types of standards methods that has been usually used in green space planning standards (Veal, 2013):

- population,
- area percentage,
- catchment area,
- facility description;
- local criterions.

In order to ensure the quality and sustainability of greenery, it is important to determine the ratio between population and area of the greenery. Quality green spaces improve the quality of life in cities by making them more attractive to residents, employees, tourists, investors and firms (Russo, Cirella, 2018).

The problem and actuality. The topic of this article is relevant because in Lithuania the assessment of the area occupied by plantations and green spaces has shown that the area standards do not meet the requirements and recommendations of the World Health Organisation. Recently, the recognition of the importance of trees and shrubs has been growing.

In order to have a healthy and sustainable environment, it is necessary to plant trees and shrubs, which will not only create a beautiful environment, but also reduce pollution, perform other functions. Quality environment with green spaces reflects purposeful planning and management.

The **object of the investigation** is trees and shrubs greenery of Vilnius and Kaunas counties.

The **purpose of the investigation** is to carry out an analysis of the change in the trees and shrubs greenery area of Vilnius and Kaunas counties in 2002 - 2023.

Goals of the research:

1. To analyze the present state of trees and shrubs greenery area in Vilnius and Kaunas counties.
2. To accomplish the analysis of the change in the area of Vilnius and Kaunas counties trees and shrubs greenery in 2002 - 2023.
3. To examine the change of trees and shrubs greenery area in the municipalities of Vilnius and Kaunas counties.

RESEARCH METHODS

Several methods have been used to prepare the research of this article: theoretical and practical.

The introduction presents an overview of articles by foreign researchers examining the concept, functions, and planning standards of trees and shrubs greenery.

The article formulates the aim and tasks for its realization.

To achieve the aim, a comparative method was used, which determined the change of tree and shrubs greenery areas in Vilnius and Kaunas counties and its municipalities in 2002–2023. The received change results are presented in hectares and percentages. The data of the Land Fund of the Republic of Lithuania for 2002–2023 were used for comparative investigation.

The method of analytical, logical analysis was used to determine the reasons for the increase in the area of tree and shrubs greenery in Vilnius and Kaunas counties.

To complement the study, 4 tables and 3 figures were prepared.

RESULTS OF RESEARCH

Current situation of tree and shrub area in Vilnius and Kaunas counties

As stated in this article, tree and shrub plantations are classified as separate green space, i.e. a park, garden, square or other green area of a city or town located on a plot of land that, depending on the use for which it is intended, is classified as separate green space.

Plots of land set aside for individual green areas are created and managed for recreational, scientific, educational, cultural, cognitive, recreational, aesthetic and other public needs. In order to create new individual public green areas or transform existing individual public green areas, it is necessary to prepare a landscaping project (Lietuvos Respublikos želdynų įstatymas, 2007).

The history of Lithuanian green spaces goes back in time. As a set of green spaces, green areas have multifunctional purposes: ecological, protective, recreational, cognitive, aesthetic, architectural, historical, cultural and psychological.

In 2023, tree and shrub plantations in the Republic of Lithuania covered 208,609.48 ha, accounting for 3.20 percent of the country's area.

In 2023, tree and shrub plantations in Vilnius county covered 45,082.20 ha or 4.63 percent of the county's area, this is more than Lithuanian average. Meanwhile, tree and shrub plantations in Kaunas county covered 21,728.15 ha or 2.69 percent. This means that in Kaunas county, tree and shrubs greenery makes up a smaller part compared to Vilnius county and the whole country.

There are eight municipalities in Vilnius county where green spaces are unevenly distributed.

An analysis of the area of trees and shrubs greenery in Vilnius municipalities shows that the largest number of trees and shrubs is found in Vilnius district (11,894.34 ha or 5.59 percent) and Trakai district (6,388.12 ha or 5.29 percent), while the smallest number of trees and shrubs is found in the municipalities of Vilnius (1,582.32 ha or 3.95 percent) and Ukmerge district (5,342.08 ha or 3.83 percent) (Table 1).

There are eight municipalities in Kaunas county. Analyzing the circumstances of the area of tree and shrub plantations in Kaunas county, it can be seen, that the largest number of trees and shrubs is found in Kasiadorys district (5,089.23 ha or 4.68 percent) (Table 2).

Table 1. Tree and shrub plantations area in hectares and percent in municipalities of Vilnius county in 2023 (by author)

Municipalities of Vilnius county	Trees and shrubs greenery area in hectares	Trees and shrubs greenery area in percent
Elektrenai	2,530.12	4.97
Salcininkai district	6,348.98	4.25
Sirvintos district	3,711.06	4.10
Svencionys district	7,285.18	4.31
Trakai district	6,388.12	5.29
Ukmerge district	5,342.08	3.83
Vilnius	1,582.32	3.95
Vilnius district	11,894.34	5.59

Table 2. Tree and shrub plantations area in hectares and percent in municipalities of Kaunas county in 2023 (by author)

Municipalities of Kaunas county	Trees and shrubs greenery area in hectares	Trees and shrubs greenery area in percent
Birstonas	454.77	3.74
Jonava district	2,297.23	2.43
Kasiadorys district	5,089.23	4.68
Kaunas	720.45	4.59
Kaunas district	3,603.82	2.41
Kedainiai district	2,542.84	1.52
Prienai district	3,470.61	3.36
Raseiniai district	3,549.2	2.26

From the above analysis, it can be seen that in all municipalities of Vilnius county, tree and shrub plantations exceeds the Lithuanian average (3.20 percent), while in Kaunas county, only four municipalities (Birstonas, Kasiadorys, Kaunas, Prienai district) exceed the national average, in the rest of the municipalities trees and shrub greenery do not reach 3.20 percent.

Changes in the area of trees and shrubs greenery in Vilnius and Kaunas counties

This paper examines the change in the area of these plantations over 21 years. In Vilnius county the area of tree and shrub plantations in 2002 was 21,697.99 ha. As can be seen from the 1st figure, the analysed area has started to increase since 2008, and in 2023 the plantation area amounted to 45,082.20 ha.

From 2002 to 2023 the analyzed area in Vilnius county increased by 23,384.21 ha (107.77 percent). The area of greenery in Kaunas county increased by 10,444.56 ha or 92.56 percent during the period under review. The reason for the increase in the area of tree and shrub plantations was the creation of legislative framework. In 2002, an Order of the Minister of Environment of the Republic of Lithuania 'On Approval of the Strategy for Protection, Management and Restoration of Green Areas' was adopted, which entered into force in 2003 (Lietuvos Respublikos aplinkos..., 2002). This legal document established principles for the protection, management and restoration of green spaces.

In 2007, the Law on Green Areas of the Republic of Lithuania (Lietuvos Respublikos želdynų įstatymas, 2007) was adopted. The aim of this Law is to establish a legal framework for the protection, management, creation of green areas and planting of greenery in the territory of the Republic of Lithuania on non-forest land, to ensure the stability of the natural and cultural landscape and the right of the population to environmental conditions that improve the quality of life. The adoption of this law and the implementation of the strategy stimulated the development of plantations in counties.

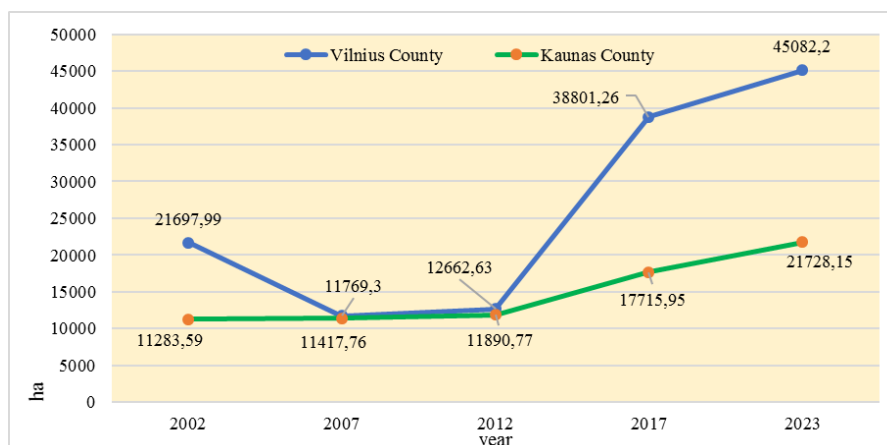


Figure 1. Trees and shrubs greenery area change in hectares in Vilnius and Kaunas counties in 2002-2023 (Nacionalinė..., 2002-2023) (by author)

So, in both Vilnius and Kaunas counties, the area of trees and shrubs greenery increased due to the implemented projects and programs and the most important is the creation of legislative framework.

Changes in the area of trees and shrubs greenery in the municipalities of Vilnius and Kaunas counties

Figure 2 shows that the area of trees and shrubs greenery in seven municipalities of Vilnius county has increased from 2002 to 2023. This means that almost all municipalities in the county have expanded their planted areas over the 21-year period.

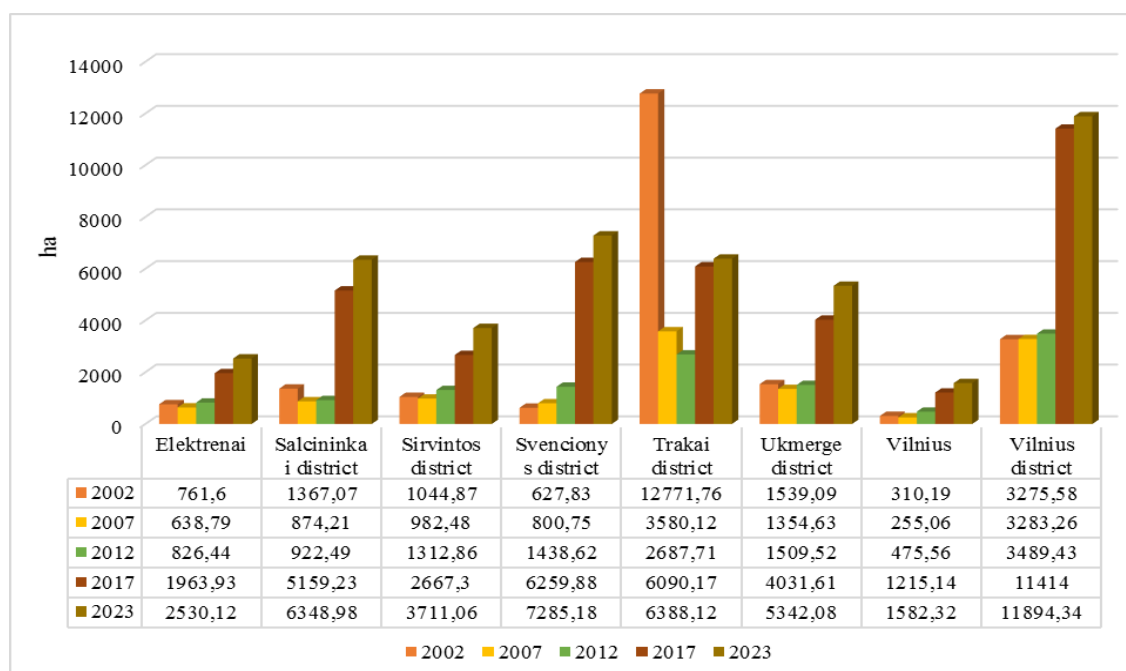


Figure 2. Trees and shrubs greenery area change in hectares in municipalities of Vilnius county in 2002–2023 (Nacionalinė..., 2002–2023) (by author)

The analysis shows that in the period between the years 2002 and 2023 the biggest increase in the area in hectares of tree and shrub plantations took place in Vilnius district (8,618.76 ha) and Svencionys district (6,657.35 ha). However, when analysing the change data in percentages, it can be seen that the most changes are in the municipality of Svencionys district (1,060.34 percent). In the only one municipality of Vilnius county – Trakai district – the area of tree and shrub greenery has decreased (6,383.64 ha or 49.98 percent) in the period of 2002-2023 (Table 3).

Figure 3 shows trees and shrubs greenery area change in hectares in municipalities of Kaunas county in 2002-2023. In this county, as well as in Vilnius county, in one municipality – Raseiniai district – the area of tree and shrub plantations has decreased (2,357.76 ha or 39.91 percent), while in all other municipalities of Kaunas county it has increased.

Table 3. Trees and shrubs greenery area change in hectares and percent in municipalities of Vilnius county in 2002-2023 (by author)

Municipalities of Vilnius county	Trees and shrubs greenery area change in hectares	Trees and shrubs greenery area change in percent
Elektrėnai	+ 1,768.52	+ 232.21
Salcininkai district	+ 4,981.91	+ 364.42
Sirvintos district	+ 2,666.19	+ 255.17
Svencionys district	+ 6,657.35	+ 1,060.34
Trakai district	- 6,383.64	- 49.98
Ukmergė district	+ 3,802.99	+ 247.09
Vilnius	+ 1,272.13	+ 410.11
Vilnius district	+ 8,618.76	+ 263.12

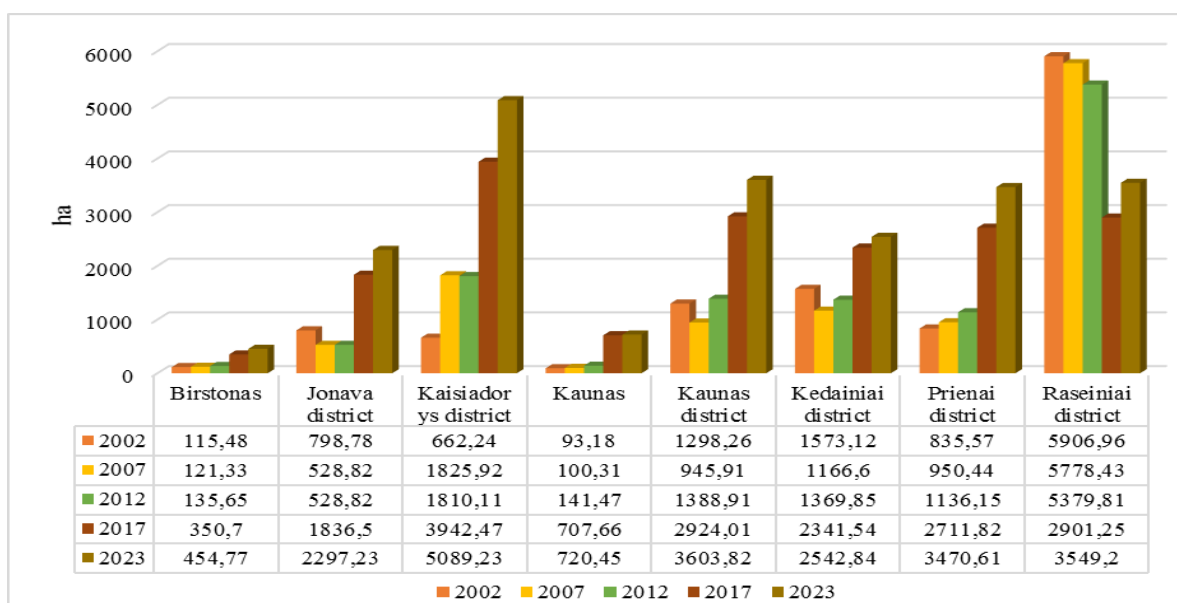


Figure 3. Trees and shrubs greenery area change in hectares in municipalities of Kaunas county in 2002-2023 (Nacionalinė..., 2002-2023) (by author)

However, the increase in the area under trees and shrubs was uneven across the municipalities of Kaunas county (Table 4).

The analysis shows that during the years 2002 and 2023 the biggest increase in the area of trees and shrubs greenery took place in Kaišiadorys district (4,426.99 ha) and Prienai district (2,635.04 ha).

Table 4. Trees and shrubs greenery area change in hectares and percent in municipalities of Kaunas county in 2002-2023 (by author)

Municipalities of Kaunas county	Trees and shrubs greenery area change in hectares	Trees and shrubs greenery area change in percent
Birstonas	+ 339.29	+ 293.81
Jonava district	+ 1,498.45	+ 187.92
Kaišiadorys district	+ 4,426.99	+ 668.49
Kaunas	+ 627.27	+ 673.18
Kaunas district	+ 2,305.56	+ 177.59
Kėdainiai district	+ 969.72	+ 61.64
Prienai district	+ 2,635.04	+ 315.36
Raseiniai district	- 2,357.76	- 39.91

It is recommended that the Trakai district municipality of Vilnius county and Raseiniai district municipality of Kaunas county would pay attention to decreasing the areas of tree and shrub plantations and carry out the development of these territories.

In 2020 the Program for monitoring the condition of green areas and plantations of the municipality of Trakai district (Deveikis, 2020) has been prepared, which includes measures for the implementation of the program for

monitoring the condition of green areas in 2021-2025. Based on this program, it is planned to clarify the reasons for the deterioration of the condition of greenery, taking into account the functional purpose of green areas, their location in different landscapes and in different areas of the municipal territory. It is also planned to determine the current state of green areas, to prepare recommendations for the restoration and preservation of tree and shrub plantations.

The municipality of Raseiniai district, solving the problems in the area of tree and shrub reduction, in 2022 approved the decision Regarding the approval of the regulations for the protection of greenery of the municipality of Raseiniai district (Raseinių rajono..., 2022). At the moment, in various territories of Raseiniai district, examinations of the condition of plantations are being carried out. Greenery development projects have been started in Raseiniai district.

It is likely, that after taking into account these recommendations, the area of trees and shrubs in Trakai and Raseiniai districts will increase.

In Trakai and Raseiniai districts, the area of trees and shrubs can be increased if the recommendations of the World Health Organization (WHO) are taken into account. The WHO (2012) recommends a minimum of 9 m² of green space per person, with an ideal green space value of 50 m² per capita.

The mentioned areas can be increased if the amendments of the Law on Green Areas of the Republic of Lithuania (Lietuvos Respublikos želdynų įstatymas, 2007) is followed. On 1 May 2023, amendments to the Law on Green Areas of the Republic of Lithuania came into force that will bring green areas closer to the population, with the norm being calculated at a closer distance from residential buildings – within a radius of up to 1 km. This is a distance that can be walked in no more than 15 minutes. Parks and squares should be created at the rate of at least 12–25 m² per inhabitant within this maximum distance, depending on whether it is a city, town or resort.

The standards for green areas in courtyards have also been increased, especially in areas with a natural framework. Where there is not enough space to create green areas, this can be compensated by vertical greening of buildings – up to 5% of the required greening area. A standard of 10 percent green space has been introduced in the central areas of large cities, which has not been the case in Lithuania so far.

The amendments to the law oblige municipalities to restore street greenery within one year if it had to be removed due to construction work or if it posed a risk to the environment or traffic safety. This is expected to help restore the green balance in urbanised areas.

It is necessary to study the existing types of greenery and trees, shrubs, introduce new ones considering the changing climate conditions and environmental pollution in order to develop a sustainable system of greenery at the country, regional, counties and municipalities levels.

CONCLUSIONS

1. In 2023, tree and shrub plantations in Vilnius county covered 45,082.20 ha, accounting for 4.63 percent of the county's area. Meanwhile, tree and shrub plantations in Kaunas county covered 21,728.15 ha or 2.69 percent. This means that in Kaunas county, trees and shrubs greenery makes up a smaller part compared to Vilnius county and the whole country.
2. From the above analysis, it can be seen that in all municipalities of Vilnius county, tree and shrub plantations exceeds the Lithuanian average (3.20 percent), while in Kaunas county, only four municipalities (Birstonas, Kasiadorys, Kaunas, Prienai district) exceed the national average, in the rest of the municipalities trees and shrub greenery do not reach 3.20 percent.
3. During the years 2002 and 2023 the area of trees and shrubs greenery in Vilnius county increased by 23,384.21 hectares or 107.77 percent. The area of greenery in Kaunas county increased by 10,444.56 ha or 92.56 percent.
4. The analysis shows that during the years 2002 and 2023 the biggest increase in the area of tree and shrub plantations took place in Vilnius district (8,618.76 ha) and Svencionys district (6,657.35 ha). In the only one municipality of Vilnius county – Trakai district – the area of tree and shrub greenery have decreased (6,383.64 ha or 49.98 percent).
5. From 2002 to 2023, in Kaunas county, in one municipality – Raseiniai district – the area of tree and shrub plantations has decreased (2,357.76 ha or 39.91 percent), while in all other municipalities of Kaunas county it has increased. Between the years 2002 and 2023 the biggest increase in the area of shrubs and greenery took place in Kasiadorys district (4,426.99 ha or 668.49 percent).

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