

CHANGES IN LITHUANIAN MEADOWS AND NATURAL PASTURE AREAS OVER A 20-YEAR PERIOD AND TRENDS

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Abstract

In Lithuania, as well as throughout Europe, the areas of natural meadows and pastures are gradually decreasing due to the intensification of agriculture, leading to the plowing of meadows and the consequent loss of valuable biodiversity, a crucial component of the landscape. The problems associated with meadow and pasture reduction is essential for informed decision-making, sustainable land management, the conservation of biodiversity and ecosystem services. Various methods, including comparative, analytical, statistical, and logical analysis, were employed in the investigation. The comparative study employed information from the Land Fund of the Republic of Lithuania covering the period from 2003 to 2023. The article also analyzes the reasons and perspectives of the decrease in meadow and natural pasture areas. In 2023, meadows and natural pastures in the Republic of Lithuania covered 362,351.79 ha, constituting 5.55% of the country's territory. From 2003 to 2023, the total area of meadows and natural pastures decreased by 135,439.55 hectares or 27.21%. From 2003 to 2023, in nine out of ten Lithuanian counties, the areas of meadows and pastures decreased. The most significant loss of these areas occurred in Siauliai County (36,828.33 ha or 59.02%), while the least loss was in Klaipėda County (141.05 ha or 0.34%). The decrease in meadow and natural pasture areas can be attributed to various factors: changes in land use, urbanization, climate change and other influencing factors. The area of meadows and pastures in Lithuania should increase by 87,000 hectares, and meadows and pastures in country would cover an area of 449,351.79 ha or 6.88% of the total area of the Republic of Lithuania.

Key words: meadows, natural pastures, area change.

Introduction

The land areas with fertile soil (agricultural land) used for agricultural activities are a limited and not easily replenishable natural resource. The preservation, rational use, and improvement of economic properties are in the public interest (Aleknavičius & Aleknavičius, 2017).

In addition to arable land and gardens, meadows and natural pastures are classified as agricultural land.

Meadows include areas covered with perennial grasses (cultivated meadows, established in peaty soils through a complex of drainage and agrotechnical measures) or naturally grown land areas (natural flooded and dry meadows) that are systematically mowed or can be mowed. Natural pastures include areas covered with natural perennial forage grasses and are used or suitable for grazing animals. Meadows and natural pastures may undergo a process of peat formation (peat meadows and pastures), and they may contain bushes, individual trees, or stones (bushy or stony meadows and pastures). Meadows or natural pastures where more than 70% of the area is covered by shrubs and trees due to overgrowth are classified as marshes (when a meadow or natural pasture is overgrown) or as wooded areas (trees and shrubs when a meadow or natural pasture is overgrown with shrubs) (Nacionalinė..., 2023).

Meadow habitats are exceptionally rich in terms of plant species diversity and are associated with various animal species, especially insects.

The preservation of the floristic compositions, individual species, and ecological functions of natural and semi-natural grasslands is crucial. Considering that these biomes are currently among the most endangered in the world (Janssen *et al.*, 2016).

Semi-natural grasslands exhibit high species diversity and offer a broad array of ecosystem services, including

biomass production for livestock grazing and carbon sequestration. The threats of land abandonment and habitat destruction jeopardize these ecosystems, underscoring the importance of restoration efforts in cases of degradation (Durbecq *et al.*, 2023).

Grasslands play a vital role in the whole Earth's system, sustaining a diverse range of fauna and flora. They also offer crucial ecosystem services: including pasture forage, clean water provision, hydrological balance, erosion prevention, pollination support, and sequestration of greenhouse gases (Buisson *et al.*, 2022).

Author Wilsey (2021) believes that grasslands contribute various ecosystem services to society, such as capturing nutrients, producing food, storing carbon, supporting tourism and recreation, and generating nectar and pollen. Culturally, grasslands hold significance as outdoor scientific laboratories.

Grasslands face growing degradation due to changes in land use and disruptions to their natural disturbance patterns, leading to fundamental shifts in their structure and functioning. This degradation heightens the importance of protecting and restoring grasslands. It may also diminish the ability to fully restore characteristics typical of pristine, old-growth grasslands (Buisson *et al.*, 2022).

Grasslands, spanning vast areas, exhibit surprising biodiversity but have been significantly altered by human activities and lack the level of protection afforded to some other biomes. Restoration efforts offer a chance to reverse this degradation and enhance local biodiversity (Wilsey, 2021).

The conversion and degradation of grasslands can happen swiftly. The most harmful disturbances are those that quickly obliterate belowground structures, including activities like land cultivation, mining, and

forestation (Bardgett, *et al.*, 2021).

With the United Nations declaring 2021–2030 as the decade of ecosystem restoration, it has become increasingly important to recognize grasslands as vital ecosystems for the preservation and restoration of terrestrial biodiversity and environmental services. Additionally, they play a key role in managing climate change (United Nations..., 2022).

Author Retallack (2013) in his science article states that contemporary agroecosystems like grasslands and pastures, subject to intensive human regulation, have the potential to serve as carbon sinks. Implementing carbon sequestration practices could prove beneficial in mitigating human-induced worldwide warming.

Pastures often have the ability to provide increased ecosystem services, and in certain instances, improve them. Typically resulting in environmental advantages and enhanced overall stability in the context of climate change (Veldkamp *et al.*, 2023).

Studies indicate that pasture systems have the potential to enhance overall productivity across the system while simultaneously offering various ecosystem services (Smith *et al.*, 2022).

The concept of ‘managed grazing’ is attracting attention for its potential role in mitigating climate change. This is achieved by minimizing bare ground, encouraging perennialization, and thereby improving the sequestration of soil carbon (Gosnell, Charnley, & Stanley, 2020).

The impact of livestock systems on environmental change is a subject of controversy. Pasture-based systems are viewed as a sustainable option because of their adaptation to utilizing local natural resources. Nevertheless, these systems have restricted productivity per unit of product and rely on public economic support in Europe. Moreover, these systems exhibit diversity in both farm structure and resource utilization, factors that can influence their overall sustainability (Muñoz-Ulecia *et al.*, 2023).

Globally, a minimum of one billion people residing in grazing ecosystems rely on these ecosystems for their livelihoods, primarily through livestock production, and for various environmental services crucial to human welfare. To ensure long-term sustainability of rangelands and ecosystem resilience, there is an immediate need for comprehensive agricultural production policies on a global scale. These policies should aim to shift from current detrimental industrial inorganic input agricultural practices to sustainable resource management that promote enhanced environmental function (Teague & Kreuter, 2020).

The object of article is meadows and natural pasture areas of Lithuania.

The purpose of this article is to conduct an analysis of the change in meadows and natural pasture areas over a twenty-year period.

Tasks to be resolved:

1. Examine the historical development and present state of meadow and natural pasture areas.
2. Investigate the change in meadows and natural pasture areas from 2003 to 2023.

3. Predict trends in the change of meadows and natural pasture areas.

Materials and Methods

Various approaches were employed in the research for this article, encompassing both theoretical and practical methods. In pursuit of the article’s objective, a comparative method was utilized to assess the transformation of meadows and natural pasture areas in Lithuania and its ten counties over the period 2003–2023. The resultant changes are presented in both hectares and percentages. Comparative analysis relied on data from the Land Fund of the Republic of Lithuania (Nacionaline..., 2003–2023) covering the years 2003–2023.

Analytical and logical analysis methods were employed to identify the factors contributing to the decline in meadow and natural pasture areas in Lithuania and its nine counties out of ten. The article highlights the observed trends in the alteration of meadows and natural pasture areas in Lithuania.

To enhance the study’s comprehensiveness, a graphical method was also applied.

Results and Discussion

Historical and current situation overview

Natural meadows and pastures are an integral part of Lithuania’s landscape and culture. These ecosystems play a crucial role in nature and in all our lives. By absorbing carbon dioxide from the atmosphere and stabilizing moisture regimes, they are important for many species, including birds and natural plant pollinators, as habitats.

Meadow ecosystems are highly important for biological diversity. Meadows are extraordinarily rich in species, hosting various wild pollinators (bees, wasps, butterflies, ants), beetles, and other invertebrates. Unique, rare, and protected plants also grow in meadows.

In Lithuania, efforts to improve meadows and pastures began in the 16th–17th centuries. Shrubs were cleared, and thickets were destroyed. The development of meadow farming was hindered by wars, plague epidemics, and various natural disasters. Meadows were overgrown with shrubs and forests. In the second half of the 18th century, meadows in the Nemunas Delta started to be drained through ditches and drainage. From the 15th to the mid-19th century, meadows occupied 12–27% of the territory of Lithuania at that time. Perennial grasses were sown in manors, and meadows were fertilized with manure.

More attention to the improvement of meadows and pastures began in the years 1928–1940 when livestock farming was more extensively developed. In 1930, natural meadows covered 13.3%, permanent pastures 8.9%, and fodder grasses 7.5% (all grasslands – about 41% of agricultural land, about 30% of the territory). In 1939–1940, meadows were 14.2%, pastures 9.4%, and fodder grasses 8.9% (about 33% of the country’s territory), and in 1951 (respectively) – 11.6%, 7.2%,

5.0% (about 24%).

Until 1941, cultivated meadows and pastures (about 50 thousand hectares) during the war and post-war period became waterlogged, overgrown with shrubs, and few fields remained with good grass.

In 1955, efforts were made to improve grassland management – to increase the fertility of grasslands, especially meadows, cultivate natural grasses, and develop grass seed production. Land reclamation specialists comprehensively performed drainage, removal of shrubs and stones, expansion of areas, construction of polders, and other land improvement works until 1992.

The cultivation of cultural grasses increased rapidly.

In 1970, natural meadows and pastures covered about 10.0%, cultural meadows and pastures about 5.4%, perennial grasses about 9.0% (about 24.5% of the territory). In 1980, cultural meadows and pastures covered about 11%, natural meadows about 5.6%, perennial grasses about 8.1% (about 24.7% of the territory). In 1990, meadows covered about 4.6%, pastures about 13.4%, perennial grasses about 9.3% (all grasslands – about 50.7% of agricultural land, about 27.3% of the territory) (Žemaitis, 2024).

In the 8th-9th decade of the 20th century, an average of about 50 thousand hectares of cultural meadows and pastures were annually established and renewed. By 1990, about 90% of all grasslands were cultivated (about 27% of the country's territory).

In the 10th decade of the 20th century, after regaining land, farmers drained many cultural pastures in drier meadows, and perennial grasses were plowed or abandoned.

According to the data of 2023 (Nacionaline..., 2023), meadows and natural pastures in the Republic of Lithuania covered 362,351.79 hectares, constituting 5.55% of the country's territory.

Analyzing the data in hectares, it is evident that in 2023, the largest areas of meadows and natural pastures were in the Vilnius (66,651.02 ha) and Utena (63,584.03 ha) counties. The smallest of these areas were identified in the Marijampole county (17,349.95 ha) (Table 1).

Nevertheless, in the calculation of percentages concerning the county's area, it was observed that Utena (8.84%) and Klaipeda (7.86%) counties have the highest proportion of meadows and natural pastures. In Lithuania, there are nine European Union importance natural meadow habitats, covering an area of 24.22 hectares (steppe meadows (1.60 ha), species-rich pastures and grazed meadows (4.19 ha), fen meadows (1.46 ha), alluvial meadows (4.22 ha), forest meadows (5.71 ha), and others (7.04 ha). Out of the nine European importance meadow habitat types present in Lithuania, the condition of all is unfavorable – either unsuitable or poor (Lietuvos republikos..., 2015).

Lithuania is a country located in the forest zone, which means that without maintaining open habitats, they naturally become overgrown with bushes, eventually forming a forest. Most of the current Lithuanian meadows have formed precisely due to livestock grazing.

Table 1

Meadows and natural pasture areas in hectares and percent in counties of Lithuania Republic in 2023

Counties of Lithuania	Meadows and natural pasture area	
	ha	%
Alytus	26,979.21	5.00
Kaunas	33,858.07	4.19
Klaipeda	41,050.04	7.86
Marijampole	17,349.95	3.88
Panevezys	36,693.28	4.66
Siauliai	25,567.85	2.99
Taurage	27,576.83	6.26
Telsiai	23,041.51	5.30
Utena	63,584.03	8.84
Vilnius	66,651.02	6.85

Source: author's calculations based on Nacionaline..., 2023.

Extensive livestock grazing and shepherding over a long period have allowed the creation of particularly valuable meadows, characterized by the abundance of plant and insect species, becoming habitats for birds, reptiles, and other living organisms.

Through extensive grazing, microhabitats and a unique diversity of plant communities are formed; cattle attract many insects, which are then followed by birds. Natural pastures and meadows can serve as carbon storage mechanisms, as plants in these areas absorb and retain carbon from the atmosphere.

The diverse vegetation in meadows and pastures helps control water flow, reducing the potential risk of erosion and contributing to improved water management.

Pastures provide an opportunity for the natural rearing of animals, allowing them to benefit from various types of fodder and obtain proper nutrition, contributing to the sustainability of animal husbandry. Meadows and pastures offer the beauty of nature and a natural environment, which holds aesthetic value and can be utilized for recreation and ecotourism.

Natural pastures can be resilient to climate change and aid in adapting to environmental shifts.

In the European Union's Biodiversity Strategy for 2030 (European Commission, 2020), it is emphasized that areas of high biodiversity value, including natural meadows, should receive special attention.

Changes in the areas of meadows and natural pastures in the Republic of Lithuania from 2003 to 2023

In this article, a study was conducted on the changes in the areas of meadows and natural pastures over a twenty-year period. In 2003, meadows and natural pastures in Lithuania covered an area of 497,791.34 hectares. As seen in the first figure, these areas decreased each year. Over the period from 2003 to 2023, the total area of meadows and natural pastures decreased by 135,439.55 hectares or 27.21%. And in the year 2023, it occupied an area of 362,351.79 'Figure 1'.

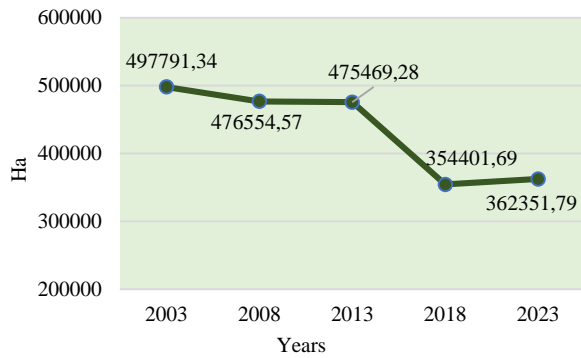


Figure 1. Meadows and natural pasture area change in hectares in Lithuania in 2003–2023 (Nacionaline..., 2003–2023).

It is worthwhile to examine how the analyzed areas changed in the country’s counties. From 2003 to 2023, in nine out of ten Lithuanian counties, the areas of meadows and pastures decreased, with only Utena County mentioned experiencing an increase in the

mentioned area ‘Figure 2’.

So, after analyzing the change in the area of meadows and natural pastures over twenty years, it was determined that the most significant loss of these areas occurred in Siauliai County (36,828.33 ha or 59.02%), while the least loss was in Klaipeda County (141.05 ha or 0.34%). As mentioned, only in the Utena County, the studied area increased (1,795.00 ha or 2.91%) (Table 2). Intensive agriculture or urbanization can result in a reduction of meadows, while conversely, sustainable agricultural practices can promote the preservation or even expansion of these areas. The reasons for the decrease in meadow and natural pasture areas in Lithuania and its counties are presented in the following section.

The causes of the decrease in meadows and natural pasture areas can be various and multifactorial.

In Lithuania, the area of meadows is gradually decreasing. This trend is also observed throughout the European Union as there is a shift away from extensive farming towards intensive agriculture, or meadows are abandoned, especially in small and infertile areas with complex terrain.

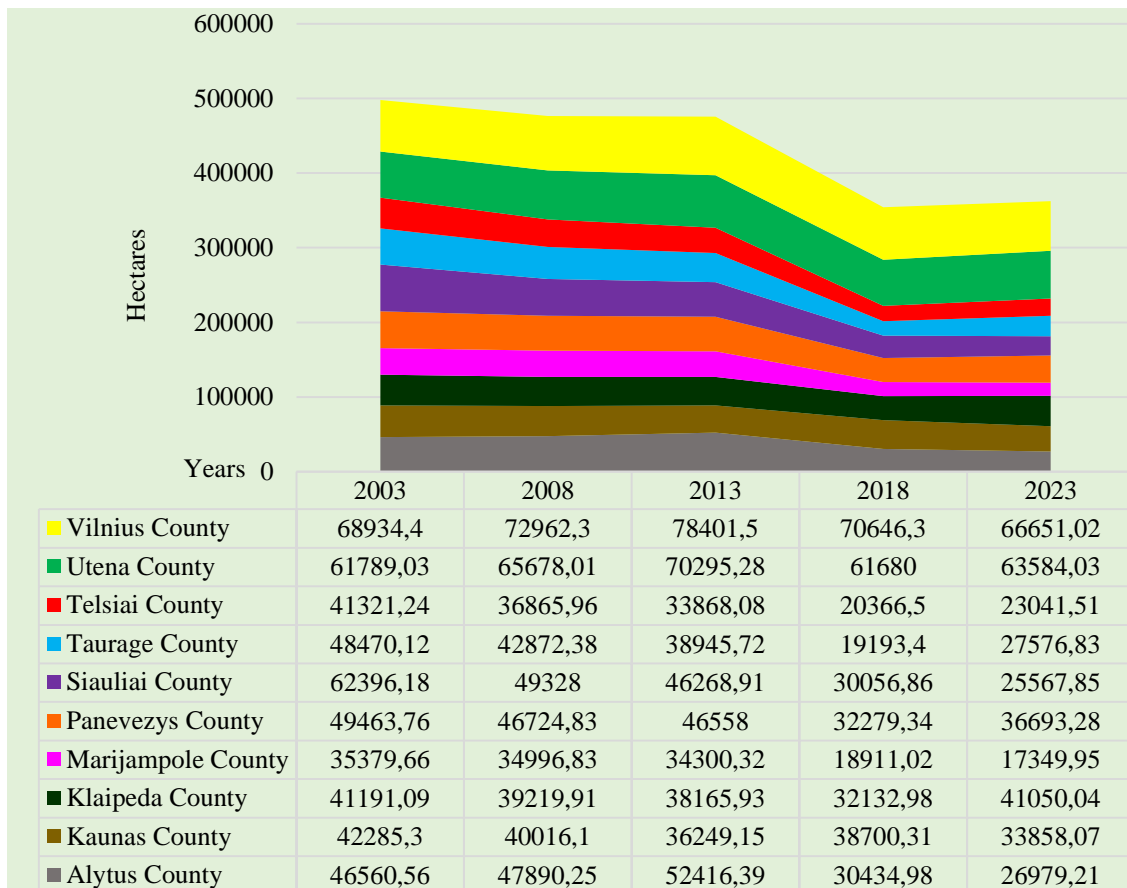


Figure 2. Meadows and natural pasture area change in hectares in counties of Lithuania in 2003–2023 (Nacionaline..., 2003–2023).

Causes and trends of decrease in meadows and natural pasture areas

The European Union influences Lithuania’s agriculture through the Common Agricultural Policy (CAP). Changes in CAP can impact land use practices and may encourage or hinder the use of meadows.

In Lithuania, similar to the entire European Union, the areas of natural meadows and pastures are gradually diminishing as agriculture intensifies, leading to the conversion of meadows into arable land. As mentioned, in Lithuania from 2003 to 2023, the area of meadows and natural pastures decreased by 135,439.55 hectares or 27.21%.

Table 2

Meadows and natural pasture area change in hectares and percent in counties in 2003–2023

Counties of Lithuania	Meadows and natural pasture area	
	ha	%
Alytus	- 19,581.35	- 42.06
Kaunas	- 8,427.23	- 19.93
Klaipėda	- 141.05	- 0.34
Marijampolė	- 18,029.71	- 50.96
Panevėžys	- 12,770.48	- 25.82
Siauliai	- 36,828.33	- 59.02
Tauragė	- 20,893.29	- 43.11
Telsiai	- 18,279.73	- 44.24
Utena	+ 1,795.00	+ 2.91
Vilnius	- 2,283.38	- 3.31

Source: author's calculations based on Nacionalinė..., 2003–2023.

Meanwhile, during the same period, the area of arable land increased by 72,181.59 hectares or 2.46%. Therefore, with the rapid development of intensive agriculture, especially crop farming, farmers are transforming meadows and natural pastures into arable land. These land use changes aim to achieve greater agricultural production and income.

The decrease in meadows and the expansion of cultivated land due to increased use of mineral fertilizers and plant protection products negatively affect the condition of water bodies and intensify soil erosion.

Another reason for the disappearance of meadows and pasture habitats is the decline in rural population and small-scale farmers, resulting in a significant reduction in domestic livestock, which were previously crucial landscape-shaping factors.

Technological progress can also influence changes in meadows and natural pasturelands. New agricultural technologies and methods can alter traditional farming practices, sometimes necessitating a reduction in extensive land areas.

Climate change can affect agricultural conditions, including potential changes in soil moisture or other environmental conditions that may impact meadows and pastures.

Additionally, abandoned meadows are often reclaimed by forests, overgrown with shrubs, or become marshy. Therefore, due to changes in land use, urban development, forestry expansion, natural transformations into wild areas, and other reasons, the areas of meadows and natural pastures in Lithuania decreased during the period from 2003 to 2023.

While in nine out of ten Lithuanian counties, there are trends to decrease meadows and natural pasture areas, there are also initiatives and efforts in these areas to increase or restore these areas. Factors that can contribute to the increase of meadows and natural pasture areas include:

1. Environmental protection and support for biodiversity: Programs and projects aimed at restoring meadows and natural pasture areas may be implemented to preserve biological diversity and environmental stability. This can be crucial from the perspective of natural ecosystems, plant life, and animal diversity.

In the Lithuanian Rural Development Program (Lietuvos kaimo plėtros..., 2023), there is a measure called 'Agrarian Environmental Protection and Climate', which additionally supports several activities aimed at preserving natural meadows.

Additionally, for the past couple of years, a pilot measure 'Conservation of Abundantly Flowering Natural Meadows' has been implemented as part of the LIFE NATURALIT integrated project. Selected farmers participate in this measure, learning to identify key plants indicating the naturalness of meadows on their land. Over the course of several years, the dynamics of meadows will be observed as they are used in the same way as farmers have used them until now. The methodology will be refined, and it is likely that after a few years, it will be included in the Lithuanian Rural Development Program.

2. Agricultural policy contributes to the conservation and development of the analyzed areas. In Lithuania, changes in agricultural policy may be implemented to promote or provide support for extensive agriculture, including meadows and natural pastures. Lithuanian farmers can receive support from the European Union under the Lithuanian Rural Development Program 2014-2020.

3. Agroecological farming practices are being implemented. Growing interest in agroecological farming systems can promote agricultural activities that emphasize ecosystem balance and natural pastures. Encouraging the country's farmers to contribute to climate change mitigation, effective natural resource management, biodiversity, and the preservation of ecosystems, habitats, and landscapes, the support for the upcoming period is linked to the requirements of Good Agricultural and Environmental Condition (GAEC). One of the requirements is the protection of perennial meadows. GAEC requirements are mandatory for all farmers, and non-compliance may result in the reduction or elimination of direct payments.

4. Development of ecotourism. Ecotourism can be promoted as an alternative to traditional agriculture, supporting natural pastures and meadows as tourist attractions. In Lithuania, the European Green Belt project 'Ecotourism Solutions for Small Rural Entrepreneurs in the European Green Belt in Lithuania' is being implemented.

Two methodologies have also been released - one for ecotourism service providers (Lietuvos kaimo turizmo..., 2023) and another offering advice for ecotourists (Lietuvos kaimo turizmo..., 2023a). The

development of ecotourism can be beneficial for local economies and community development, as well as environmental conservation. To foster this type of tourism, an integrated approach involving economic, environmental, and ethical processes is necessary, with the engagement of stakeholders.

5. Scientific research and education: scientific research on the importance of meadows and natural pastures to ecosystems can influence policy formation, while educational activities can promote understanding of the value of these areas.
6. The restoration of meadows and natural pastures. The restoration of meadows and natural pastures is a process aimed at restoring or returning the former condition of meadows and natural pastures. This can be important for preserving biodiversity, environmental sustainability, and the traditional agricultural landscape.

Farmers, when applying for support for agricultural land and other areas, as well as livestock, annually committed not to plow perennial meadows. However, following a demand from the National Payment Agency under the Ministry of Agriculture, they are now required to restore these meadows if the proportion of perennial grassland to the total agricultural land area in Lithuania decreases by more than 5%. Maintaining perennial meadows was one of the three eligibility requirements for farmers from 2015 to 2022, and those who fulfilled this obligation received basic direct and decoupling payments. It is estimated that the area of perennial meadows that farmers will need to restore is about 87,000 hectares, representing 69% of the total plowed area. The restoration of perennial meadows will need to be declared when reporting crop areas in 2024. This obligation applies to farmers who plowed more than 0.5 hectares of perennial meadows between 2020 and 2022. They will need to restore the plowed area with perennial meadows during that period. It is important to note that the restoration of perennial meadows can be done in various ways – it is not necessary to do it in the same area or location. Meadows can be restored in a different location, as long as the restored meadows are maintained and declared for five consecutive years from 2024. Therefore, if farmers fulfill their obligations, the area of meadows and pastures in Lithuania should increase by 87,000 hectares, and meadows and pastures in the country would cover an area of 449,351.79 hectares or 6.88% of the total area of the Republic of Lithuania.

Preservation of meadows is an important action in the pursuit of mitigating climate change: meadows absorb carbon dioxide, preventing a significant decrease in soil

organic carbon content. Their preservation contributes to maintaining and protecting biodiversity, including rare and native species and their habitats. Meadows and pastures are crucial elements of cultural landscapes, contributing to landscape aesthetics and identity.

Preserving meadows and natural pastures is a challenge related to sustainable agricultural development, nature conservation, and environmental sustainability. This requires an integrated approach involving both farmers and the public, aiming to balance economic activities with nature conservation.

Conclusions

1. In Lithuania, efforts to improve meadows and pastures began in the 16th-17th centuries. From the 15th to the mid-19th century, meadows occupied 12–27% of the territory of Lithuania. In 1930, approximately 41% of agricultural land and around 30% of the country were occupied by meadows and pastures. In 1970, natural meadows and pastures covered about 10.0%, cultural meadows and pastures about 5.4%. By 1990, 90% of all grasslands had been cultivated, constituting about 27% of the country's territory. In 2023, meadows and natural pastures in the Republic of Lithuania covered 362,351.79 hectares, accounting for 5.55% of the nation's land area. It was noted that Utena County had the highest percentage of meadows and natural pastures at 8.84%, followed by Klaipeda County with 7.86%.
2. In Lithuania, from 2003 to 2023, there was a decline of 135,439.55 hectares, equivalent to 27.21%, in the overall area of meadows and natural pastures. It was found that the most substantial reduction in these areas took place in Siauliai County, with a loss of 36,828.33 hectares, accounting for 59.02%. Conversely, Klaipeda County experienced the least decline (141.05 ha or 0.34%). Notably, Utena County was the only county in Lithuania, where the studied area increased by 1,795.00 ha or 2.91%.
3. The factors that can contribute to the increase of meadow and natural pasture areas include: support for environmental protection and biodiversity, agricultural policy, agroecological farming practices, development of ecotourism, scientific research and education, and national or international support programs, the restoration of meadows and natural pastures. The meadow and pasture area in Lithuania is expected to grow by 87,000 ha, resulting in a total coverage of 449,351.79 ha or 6.88% of the entire territory of the Republic of Lithuania.

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