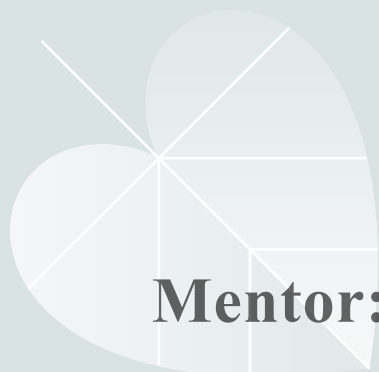




University of Belgrade
Faculty of Forestry



Protective forest belts for environmental enhancement in the area of Bačka Palanka

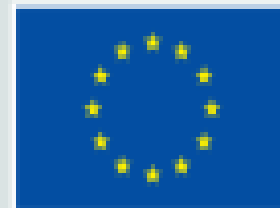


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the European Union**

As a result of the project "Agroforestry Practices in the West Balkans for Sustainable Development: Weaknesses and Strengths" (AGFORWEB), funded by the European Union through the ERASMUS+ Program KA-220-HED – Higher Education Partnership (Ref. No. 2022-1-RS01-KA220-HED-000089900), a database and the textbook "Agroforestry Systems" (Lukić S., Beloica J., 2024) were developed, which were used in the preparation of this paper.

Introduction

Land degradation processes in the studied area

- **Wind erosion** occurs due to the activity of wind, which has the ability to erode, transport, and deposit soil material.



- Intensified agricultural production can lead to significant changes in soil quality.
- Soil degradation is not only an environmental issue, but it can also be viewed as a socio-economic and political problem
- Conventional agricultural systems involve the leaching of significant amounts of fertilizers from agricultural land

Environmental effects of protective forest belts

- Protective forest belts represent an excellent measure for the maintenance and enhancement of biodiversity in a given area.
- They provide habitat, food, and shelter for a large number of wildlife, birds, and insects.
- If pollinator species are included in the shelterbelts, the population of pollinating insects increases.



- They help ensure the even distribution of snow across the entire field area.
- Protective forest belts have proven to be highly effective in reducing carbon emissions from anthropogenic sources.

The main objectives are:

- **Assessment of the potential for protecting arable land from wind erosion and improving ecological conditions in agricultural production through the establishment of shelterbelts.**
- **Assessment of the potential for preserving and enriching the biodiversity of the area by using native species to establish shelterbelts**

Study area – municipality of Bačka Palanka



Location

The municipality of Bačka Palanka is a local government unit in the Republic of Serbia. It is located in the Autonomous Province of Vojvodina and belongs to the South Bačka Administrative District. The territory of the municipality covers an area of 579 km².

Climate

The Bačka Palanka area has a moderate continental climate with characteristics of a lowland climate. The average annual temperature is 11.5°C. Winters are occasionally extremely cold, while summers are very hot. The absolute maximum air temperature recorded in this area was 39.5°C, while the lowest temperature, measured in January, was -25°C.

Relief

The area of the Bačka Palanka municipality spans across all morphological units characteristic for Vojvodina, except for sand dunes.

Protected Areas of the Municipality

- The "Tikvara" nature park is located on the left bank of the Danube river and is under protection regimes of the second and third degrees.



The "Bagremara" special nature reserve is under protection regimes of the first and second degrees and is the only natural habitat of the species *Eranthis hiemalis* (L.) Salisb in Serbia.



The Karadorđevo Special Nature Reserve is home to 135 bird species, which is why it has been declared an area of international importance for birds.



Forest cover degree

- In the area of the municipality of Bačka Palanka, the total forested area covers 3961,24 ha. In 2020, the municipality of Bačka Palanka lost large areas of forest. The cutting of protected parks of the second and third categories was carried out, as well as clear cutting in the protected area of Bagremara and the Tikvara Nature Park.



Materials and Methods

Assessment of Area Sensitivity to Wind Erosion

A conceptual model developed for the Vojvodina region in a GIS environment was applied to determine the sensitivity of the Bačka Palanka municipality area to wind erosion.

Soil

Agrochemical soil analyses were conducted to obtain fertilization recommendations for the plots used by the company Al Rawafed DOO, covering a total area of 1,086.27 ha.

Current Vegetation Status and Determination of Potential Vegetation

To determine the potential vegetation in the Bačka Palanka municipality area, the EuroVegMap program was used. Data on existing agroforestry belts in the studied area were retrieved from the AGFORWEB project database.

Climate Conditions

For the purposes of this research, calculations related to the climate conditions of the area were performed to determine the direction of the dominant wind. Afterward, a wind rose diagram was created.

The assessment of the annual temperature and precipitation trends (average monthly values) was carried out using the climate diagram by H. Walter.



Storms

In the past few years, specifically in the period of 2023/2024, the residents of Bačka Palanka have witnessed frequent natural disasters as a result of climate change. On July 19 and 21, 2023, a storm occurred in the municipality of Bačka Palanka, causing significant material and environmental damage.

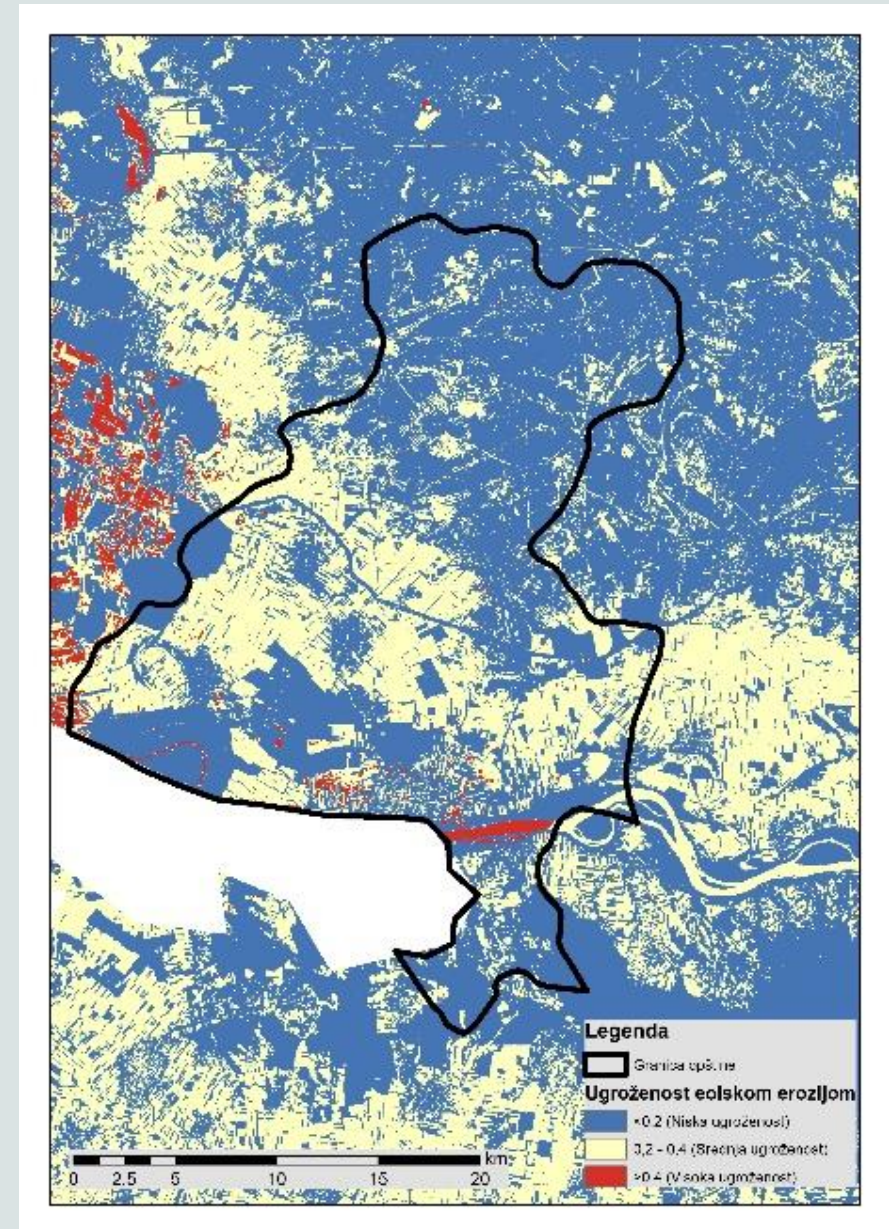
Hundreds of hectares of crops were destroyed, and thousands of trees were lost. The stormy weather recurred in the municipality less than a year later, on June 3, 2024. This time, it was accompanied by hail, which again destroyed large areas of crops and caused material damage to public and residential buildings.

Results and discussion

Assessment of Area Sensitivity to Wind Erosion

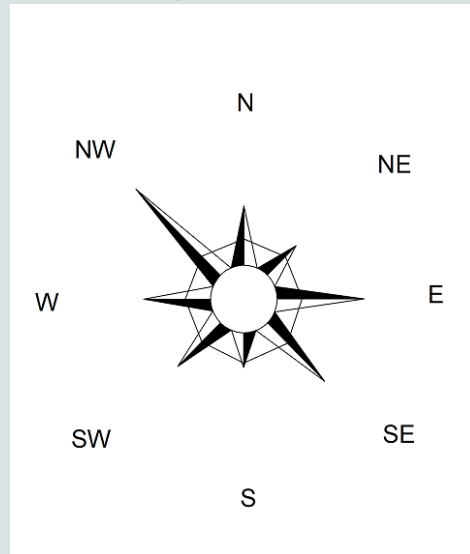
According to the results of the sensitivity assessment of the studied area to wind erosion, obtained through the application of the conceptual model, the central part of the municipality is exposed to the impacts of wind erosion of moderate intensity.

The results indicate that 42.9% of the total area of the municipality is under low impact from wind erosion, while moderate erosion risk affects 46.5% of the area, and 10.6% of the total territory of Bačka Palanka is under high risk of erosion.

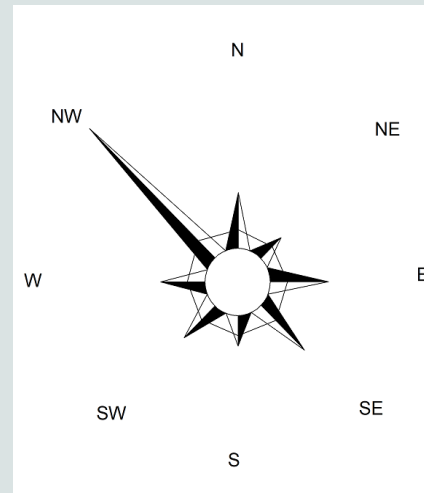


Climate Conditions

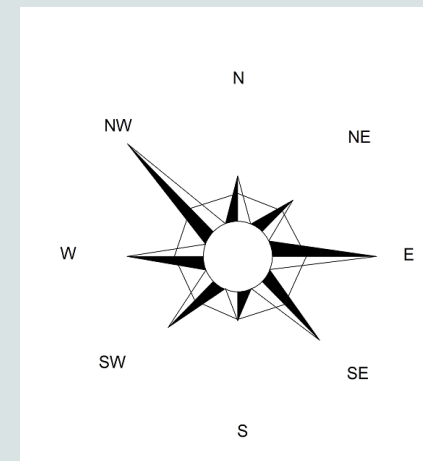
After processing the data obtained from the annual publications of the Republic Hydrometeorological Institute (RHMI) for the hydrometeorological station in Bački Petrovac for the period 2008-2018, data on the dominant winds for both the non-vegetative and vegetative periods were obtained, as well as the average annual data and a graphical representation of the wind rose.



Ружа ветра за просечну
годину

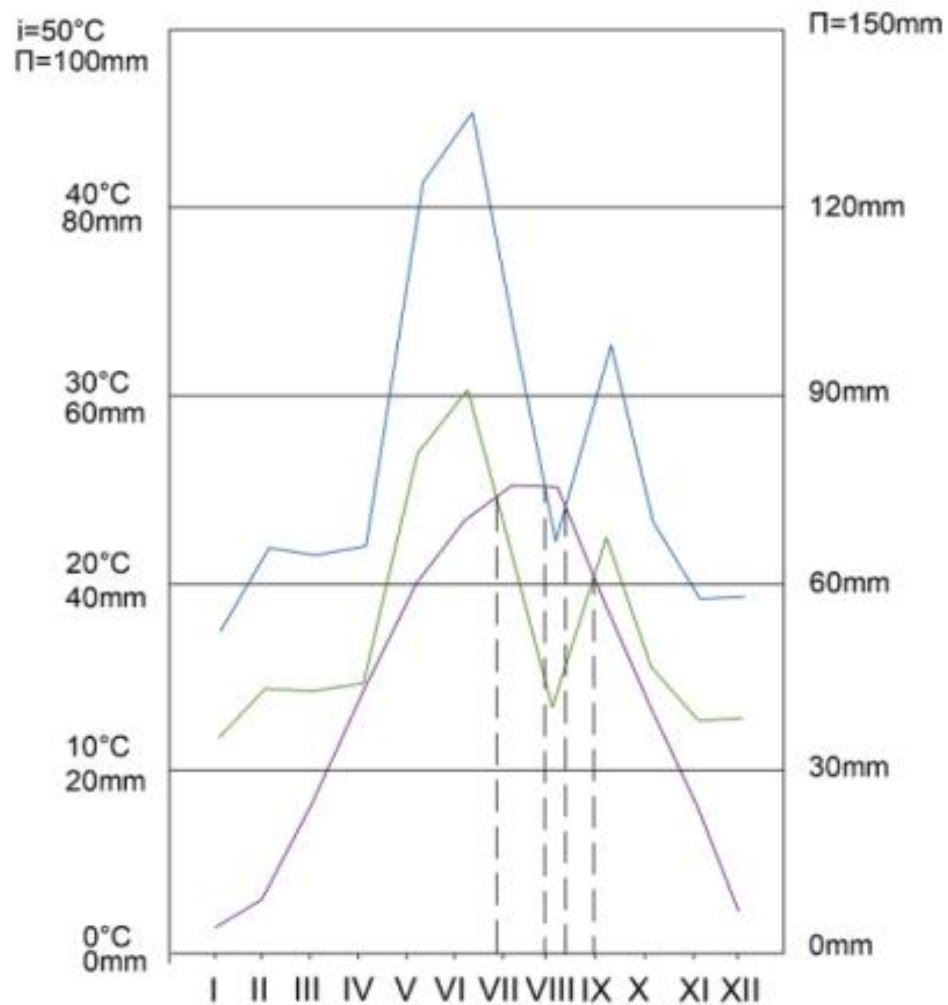


Ружа ветра за
вегетациони период



Ружа ветра за
ванвегетациони период

Климадијаграм по Н.Валтер-у
Метеоролошка станица Бачки Петровац



- By creating the climate diagram according to Walter, it was determined that the potential drought period can be expected from June 25 to August 30.
- The period of guaranteed drought is estimated for the month of August, specifically from August 1 to 15

Soil

From the collected data, it can be concluded that the soils on which the analyses were performed are weakly alkaline, with an average pH of 7.50 (classification according to Thun).

The content of CaCO_3 varies in different percentages, ranging from 0.1% to as much as 21.24%.

The content of P_2O_5 and K_2O , classified according to *Manojlović et al., 1988*, ranges from medium (10.12/8.79 mg/100g) to toxic (90.8/64.35 mg/100g) values.



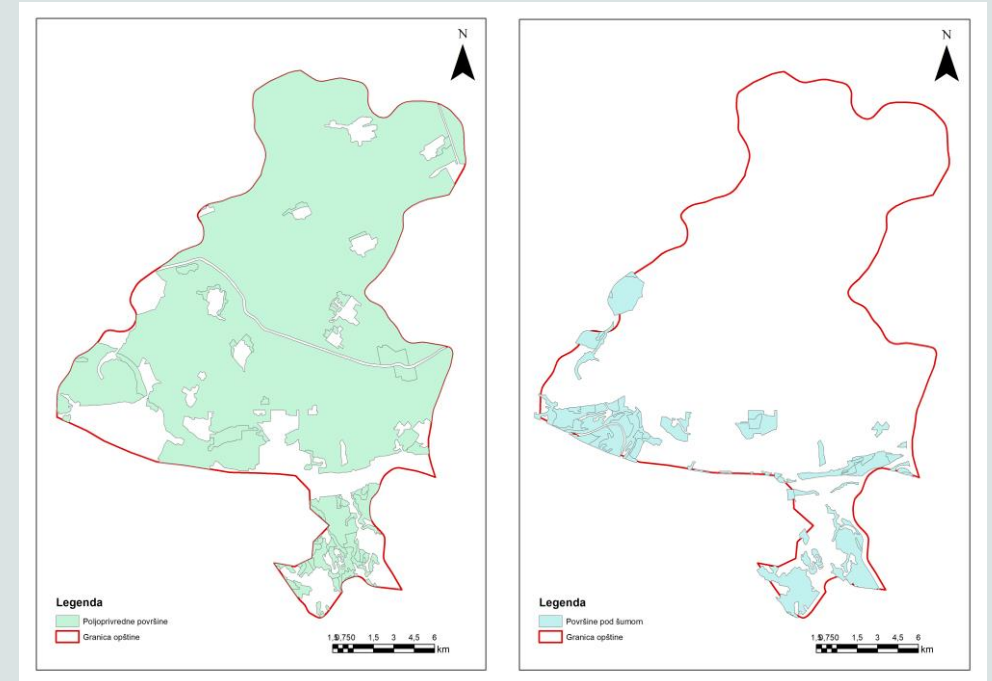
- The maximum humus content is 3.98%, while the lowest humus percentage is found on the plots in Mladenovo, with a value of 1.03%.
- According to the soil classification based on humus content by Gračanin and Škorić (1961), the soils in this area are humous to weakly humous.

Current status of the protective belts

The municipality of Bačka Palanka, in collaboration with the Faculty of Forestry from Belgrade, developed a project for shelterbelts in the entire municipality in 2001 (Dožić et al., 2001). The main objectives of establishing the belts were:

- Protection of soil from wind erosion processes and
- Increasing the forest cover in Vojvodina.

- The area covered by protective belts is 4,013 ha.
- The dominant species is the Siberian elm (*Ulmus pumila*).
- The area under arable land is 48,041.016 ha.
- In relation to agricultural land, the belts occupy only 0.01%.



Arable land

Forest land

Data on the vegetation characteristic of the studied area were obtained from the EuroVegMap database.

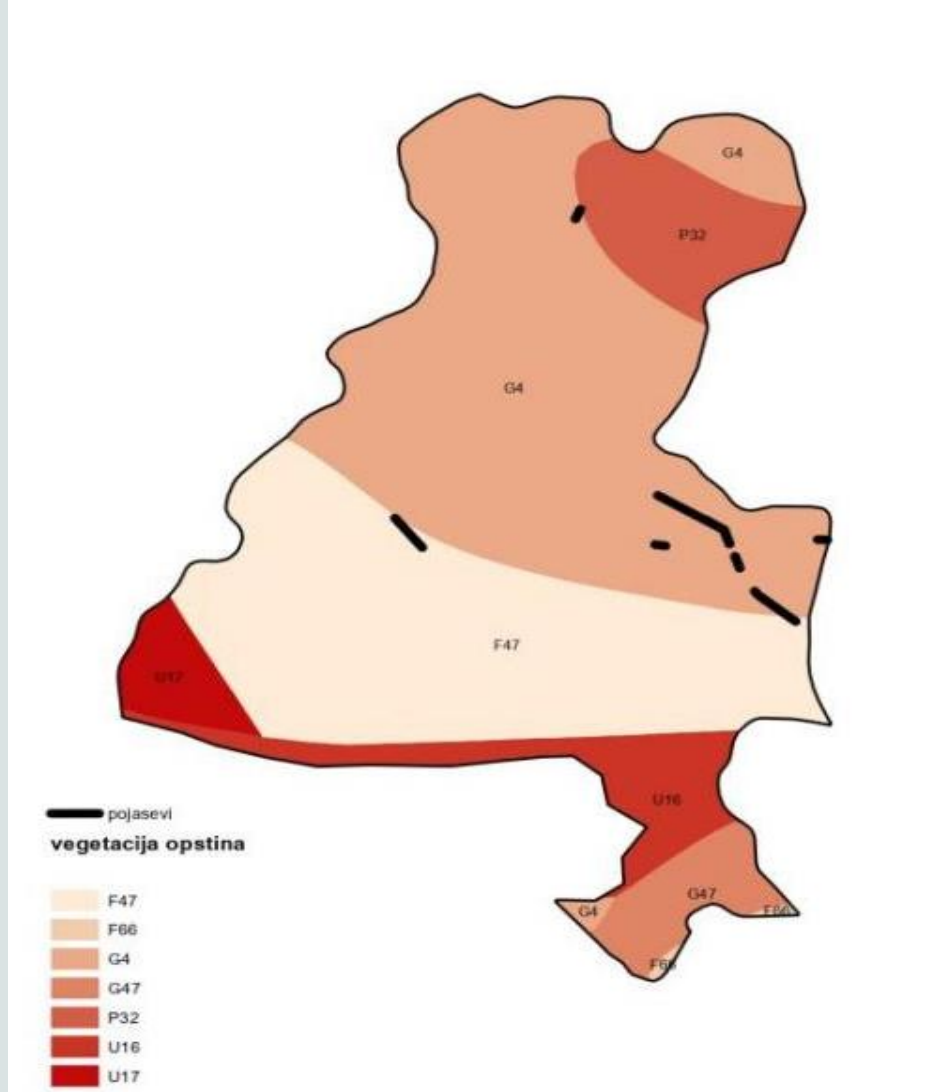
AGFORWEB

9 Belts

The dominant species is the Siberian elm (*Ulmus pumila*), although the presence of the Pennsylvania ash (*Fraxinus pennsylvanica*), Black locust (*Robinia pseudoacacia*), Silver birch (*Betula pendula*), and Black pine (*Pinus nigra*) has also been recorded.

Most of the recorded belts consist of two rows.

Irregular maintenance.



Selection of species for the field shelterbelts

- When selecting species for the establishment of field shelterbelts, species should be chosen that are in accordance with the climatic, pedological, and phytocenological characteristics of the area.
- Species from the natural potential vegetation of the studied area, which are desirable to use for the establishment of shelterbelt systems

КОД	Спрат дрвећа	Спрат жбуња
F47	Црни јасен (<i>Fraxinus ornus</i>), Клен(<i>Acer campestre</i>)	Калина (<i>Ligustrum vulgare</i>)
F66	Млеч (<i>Acer platanoides</i>), Граб(<i>Carpinus betulus</i>)	Дрен (<i>Cornus mas</i>)
G4	Лужњак (<i>Quercus robur</i>), Жешља (<i>Acer tataricum</i>)	Свиб (<i>Cornus sanguinea</i>)
G47	Лужњак (<i>Quercus robur</i>), Граб (<i>Carpinus betulus</i>)	Свиб (<i>Cornus sanguinea</i>)
U16	Бела топола (<i>Populus alba</i>), Клен (<i>Acer campestre</i>)	Калина (<i>Ligustrum vulgare</i>)
U17	Пољски јасен (<i>Fraxinus angustifolia</i>), Врсте из рода топола (<i>Populus species</i>)	Жешља (<i>Acer tataricum</i>)

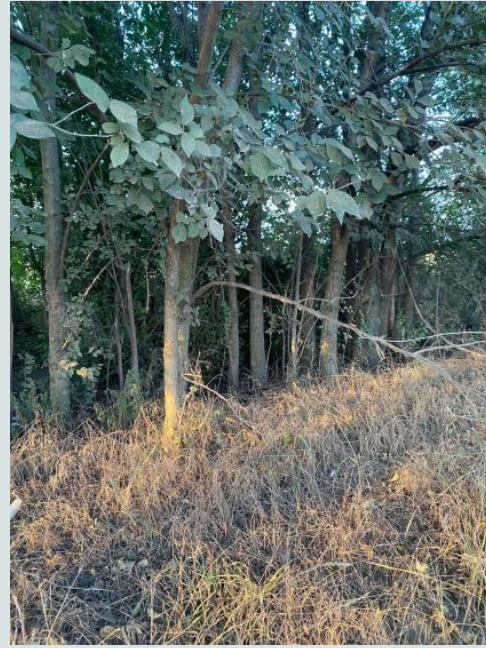
Nova Gajdobra

Nova Gajdobra is a settlement in Serbia, located in the municipality of Bačka Palanka, in the South Bačka District. According to the 2011 census, it had 1,220 inhabitants. This small village is 10 km away from the town of Bačka Palanka and 34 km from Novi Sad.

- In the 2001 project, a field shelterbelt named NG10 was designed for this location.
- The belt was constructed with 2 rows of Black locust and 2 rows of Black walnut, with one smaller section consisting of only 2 rows of Black locust.
- Part of the belt has survived, but it is not in good condition, which is why it needs to be reconstructed.



The soil type at this location is calcic chernozem (Calcic Chernozem).



- The section of the shelterbelt that has survived to this day is composed of Black locust (*Robinia pseudoacacia*) and Siberian elm (*Ulmus pumila*), and is currently in poor condition due to irregular maintenance.
- A dense stand has formed in the shelterbelt.
- The functionality of the shelterbelt has been reduced



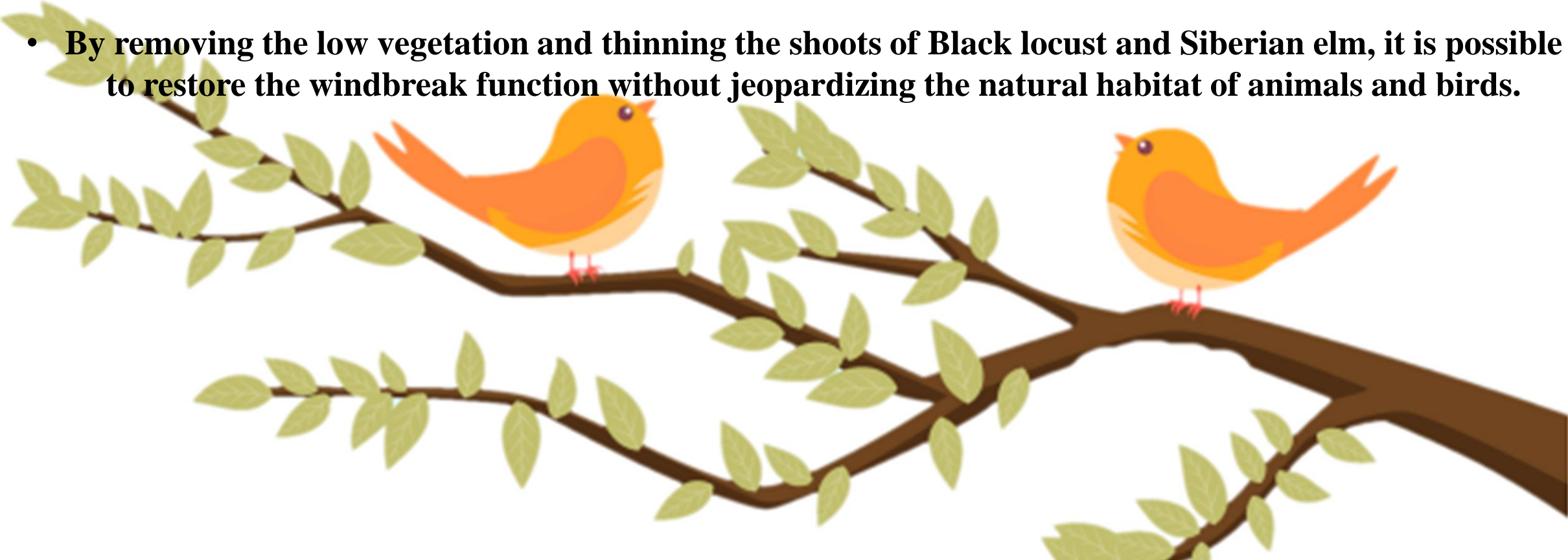
- **The belt is used as a landfill.**

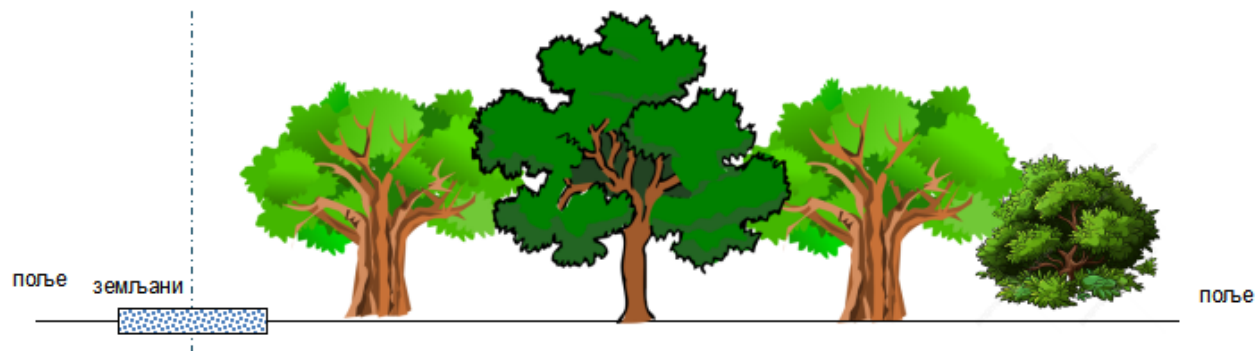
- **Potential for the development of diseases and pests.**

- **From a biodiversity perspective, removing the existing section is not justified.**

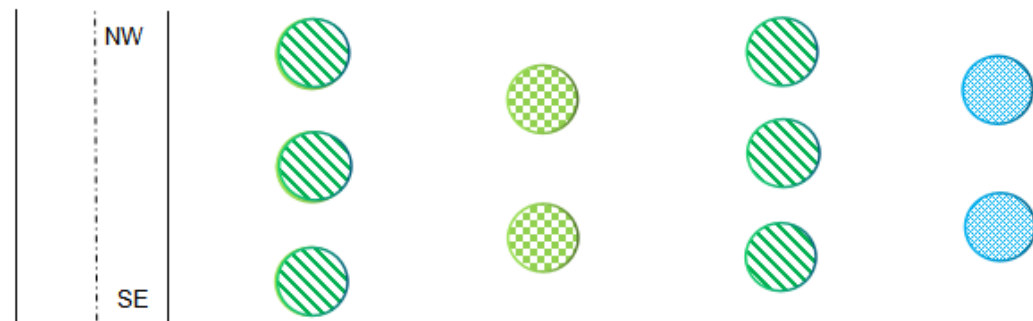
- **This belt has become a habitat and shelter for birds and wildlife.**

- **By removing the low vegetation and thinning the shoots of Black locust and Siberian elm, it is possible to restore the windbreak function without jeopardizing the natural habitat of animals and birds.**





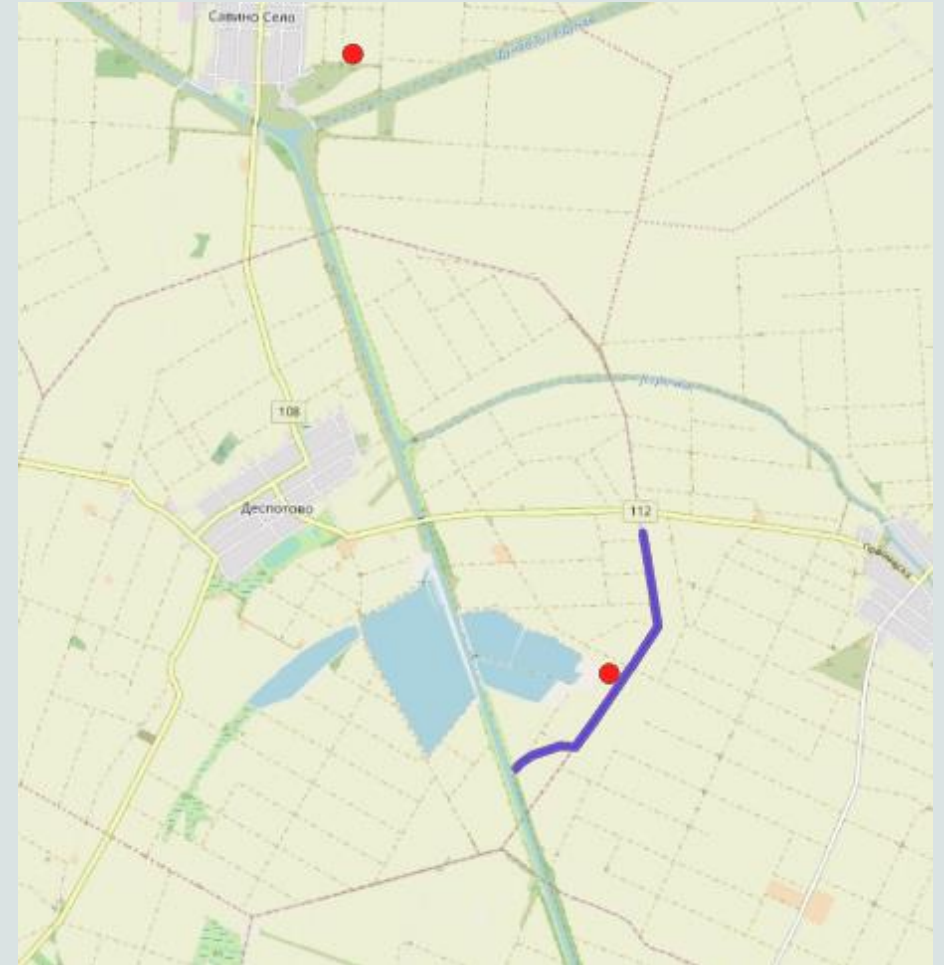
Број реда	I		II		III		IV	
Размак у реду	3		4		3		4	
Размак редова	1	3		3		3		1
Број садница	484		363		484		484	
Врста	Жешља		Лужњак		Жешља		Свиб	



- On a section with a total length of 1450 m and a width of 12 m, it is proposed to establish a shelterbelt in 4 rows, with the following species: Maple (*Acer tataricum*), Pedunculate oak (*Quercus robur*), and Dogwood (*Cornus sanguinea*).
- The selected species belong to the naturally potential vegetation of this area.
- The soil characteristics of the site also meet the requirements of these species in relation to the substrate.
- Such a shelterbelt would play a significant role in reducing wind speed, mitigating wind erosion, and supporting the survival of the indigenous species of the locality, while also providing habitat for many animals.

Despotovo

- The location selected for the proposal of the shelterbelt in the territory of Despotovo is designated through land consolidation as a space for establishing the shelterbelt.
- The area for the shelterbelt is 3300 m long and 8 m wide, and it extends along the drainage canal.
- According to the naturally potential vegetation, this part is marked with code P32, characterizing it as a marsh (solonchak soil type).
- These substrate limitations indicate the need to pay special attention to the selection of species to be used in the establishment of shelterbelts





In the vicinity of the selected location, there is the "Jegrička" Nature Park, which is a habitat for rare and protected plants such as the White water lily (*Nymphaea alba*), Marsh fern (*Thelypteris palustris*), Water chestnut (*Trapa natans*), Bladderwort (*Utricularia vulgaris*), and others; approximately 190 registered bird species; a large number of fish, amphibians, and reptiles.

Although the selected location is not within the boundaries of the nature park nor in proximity, the management plan for the protected area was certainly taken into account when proposing the reconstruction of the shelterbelt.

- Alongside the drainage canal, the shelterbelt extends, with segments of vegetation occurring.
- On the first section, 1350 m in length, the dominant species is Black locust (*Robinia pseudoacacia*), followed by a 300 m section used as agricultural land.
- In the next approximately 900 m, the shelterbelt alternates between Black locust (*Robinia pseudoacacia*) and Siberian elm (*Ulmus pumila*) as the dominant species.
- The remaining part of the belt, about 700 m, is overgrown with weeds and reed, with the presence of individual trees such as White poplar (*Populus alba*), White willow (*Salix alba*), and Elderberry (*Sambucus nigra*), in combination with Siberian elm (*Ulmus pumila*).
- Some of the accompanying species recorded in the field include Mulberry (*Morus alba*), Walnut (*Juglans regia*), Wild rose (*Rosa canina*), and Blackthorn (*Prunus spinosa*).



- On this shelterbelt, as well as on the one in Nova Gajdobra, improper maintenance and management of the shelterbelt are evident. The entire belt is overgrown with vegetation, and the trees within it obstruct the airflow.
- On this shelterbelt, a larger amount of garbage has also been noticed along its entire length.
- Relocation of the field road into the shelterbelt area.



Selection of species for the establishment of shelterbelts in Despotovo



Quercus robur



Ulmus minor



Pyrus pyraster



Fraxinus angustifolia



Ailanthus glandulosa



Eleagnus angustifolia



Amorpha fruticosa



Gleditschia triacanthos

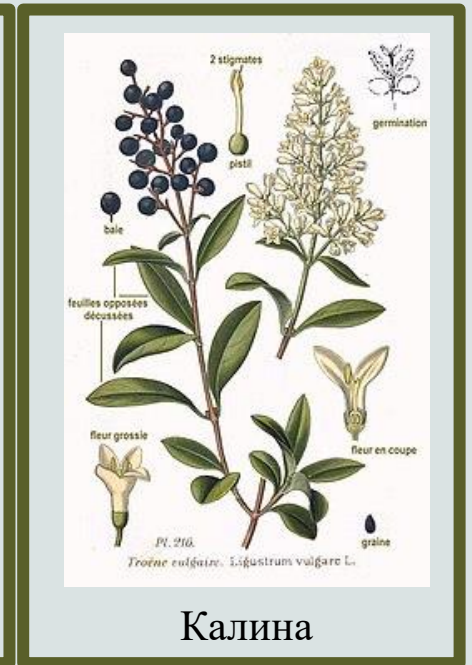


Acer tataricum



Ligustrum vulgare

- Species recommended for the initial phase of the reconstruction of this shelterbelt include Tatarian maple (*Acer tataricum*) and Common privet (*Ligustrum vulgare*).
- It is proposed that two sections of the current shelterbelt, each 300 meters in length, remain in place to serve as temporary habitats for wildlife."



- The sections of the shelterbelt that will not be removed must be thinned and cleared.
- After a maximum of 10 years, these segments need to be completely replaced with the recommended species.
- When removing trees, special attention should be given to the sections dominated by Black locust (*Robinia pseudoacacia*).

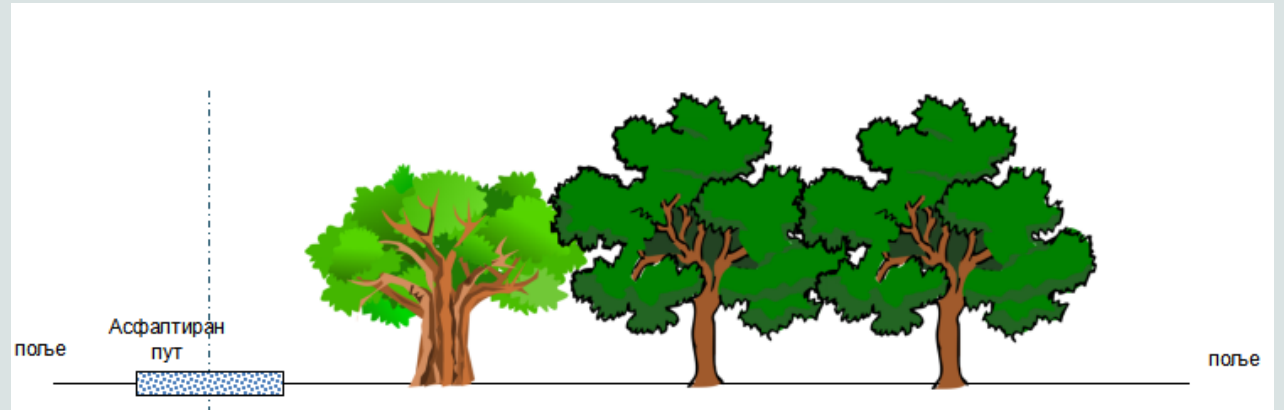


Bačka Palanka



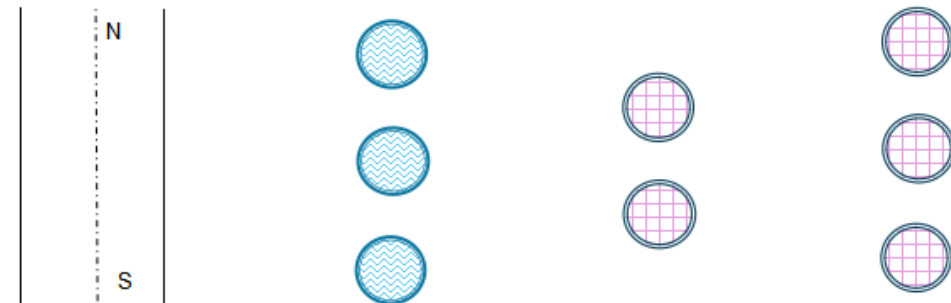
- According to data obtained from the land registry, there is a space of 15 m in width on the selected location designated for a rural road and shelterbelt.
- However, this section, along its entire length of 2040 m, has an asphalted road (commonly known among locals as Kerekić), which further connects to the rural road leading to the settlement of Čelarovo.
- In addition to the mentioned asphalt road, there is an area of 8 m in width that can be utilized for the construction of a field shelterbelt.
- The soil type in the area designated for the field shelterbelt is carbonated meadow chernozem. The vegetation of this area is classified under code G4.

- Although there is 8 m of available width for the establishment of the shelterbelt at this location, the decision is to create a smaller spacing between the rows in order to provide more space near the road.
- This approach ensures a higher survival rate for the seedlings and enhances road safety, as heavy agricultural machinery, which often exceeds the width of the road, passes daily on this route.
- For the same reason, two tree species have been selected, without including shrub vegetation.
- To establish this shelterbelt, it is necessary to secure 680 seedlings of Rowan and 1360 seedlings of Hornbeam.



Слика 23. Скица основе пољезаштитног појаса

Број реда	I	II	III
Размак у реду	3	3	3
Размак редова	2	2,5	2,5
Број садница	680	680	680
Врста	Оскоруша	Клен	Клен



Слика 24. Попречни пресек појаса

Preparation of the soil for planting

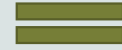
- The majority of the plots designated for the establishment of the field shelterbelts do not require special soil preparation
- In cases where the land is not used for agricultural purposes, it is recommended to perform subsoiling before planting.



It is also necessary to allocate time and provide machinery for pit excavation.



Measures for care and protection of shelterbelts



Priority in the first 5 years after planting



- **Monitoring of shelterbelts**
- **Soil cultivation and weed removal**
 - **Watering of seedlings**
 - **Protection against diseases**
 - **Protection against wildlife**
- **Supplementing damaged shelterbelts**
 - **Proper pruning of seedlings**





Conclusion

Field shelterbelts play a key role in improving the environment in the area of Bačka Palanka, providing significant ecological, climatic, and economic benefits.

The current state of shelterbelts in the municipality is not in an optimal condition.

It is crucial to pay special attention to educating the population, particularly the youth, and directly involving them in the process of developing and implementing field shelterbelt projects.

Field shelterbelts in Bačka Palanka represent a critical component of the environmental conservation and sustainable development strategy.

A landscape photograph showing a stark contrast between a dry, cracked earth on the left and a vibrant green field on the right. A tree stands at the boundary, with its left side bare and its right side full of green leaves. The sky is blue with a bright sun on the right, creating a lens flare effect.

**THANK YOU FOR YOUR
ATTENTION**