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# LIMITING FACTORS OF THE SOILS FROM DUMBRAVA, TIMIȘ COUNTY

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***Abstract**: The paper presents the detailed analysis of the main components of the natural environment – soil, water and land – as well as the proposed measures for their conservation and sustainable use, in accordance with the principles of sustainable development. The study is based on data extracted from the geotechnical and hydrogeological study of Dumbrava commune (2020), integrating information on the geological structure, soil conditions and local hydrogeological regime. The predominant soils are luvosols (47%), gleiosols (24%), planosols (15%) and eutricbosols (9%), characterized by average fertility and susceptibility to erosion, water stagnation and acidification. For their conservation, it is recommended to apply organic fertilizers, drainage, anti-erosion works and afforestation of the slopes. Water resources include groundwater with a variable level between 0.5–10 m and deep waters, fed by rainfall and high areas. Their sustainable management involves protecting infiltration areas, monitoring water quality and rational use of resources for irrigation. The lands and ecosystems of the commune offer a diverse potential: the Bega meadow is favorable for agricultural crops, and the hilly area for fruit plantations, vineyards and forests. The chapter emphasizes the need for an integrated management of natural resources, based on the balance between economic activity, environmental protection and community needs, as a prerequisite for the sustainable rural development of Dumbrava commune.*

***Keywords:** sustainable, management, limiting factors, soil,*

## INTRODUCTION

The sustainable management of natural resources is an essential pillar of rural development and environmental conservation. Soils, groundwater, vegetation and forests are fundamental elements of the local ecosystem, playing a decisive role in maintaining ecological balance, sustaining agricultural production and ensuring quality of life. In the context of climate change and increasing anthropogenic pressure, the conservation and responsible use of these resources is becoming a pressing necessity.

Soil is the basis of agricultural productivity, influencing the ability of land to support diverse crops and maintain natural nutrient cycles. In Dumbrava commune, luvosoils and gleiosols are predominate, with medium to low fertility, which require improvement by applying organic and mineral fertilizers, drainage and acidity correction. Protecting soil from erosion and compaction is essential to maintain agricultural production capacity and prevent long-term degradation.

Water resources, both underground and surface, play a central role in providing the moisture needed for agriculture and maintaining hydrogeological balance. Groundwater at varying depths, fed mainly by rainfall, makes the system vulnerable to drought and pollution. Sustainable management involves protecting pollution sources, monitoring water quality and level, as well as implementing efficient irrigation and drainage systems, adapted to soil typology.

Vegetation and forests contribute significantly to protecting soil against erosion, regulating hydrolic regimes and maintaining ecosystem stability. The hilly areas of the

commune are suitable for forests and vineyards or fruit plantations, which not only reduce the risk of erosion, but also support the development of a diversified rural economy. Maintaining natural meadows and pastures in areas with heavy or moist soils ensures the continuity of traditional habitats and protects local biodiversity.

Biodiversity is an indicator of the health of ecosystems and reflects the balance between anthropogenic activities and the natural environment. Forests, meadows, wetlands and perennial crops provide habitats for a variety of plant and animal species. The conservation of these habitats through afforestation strategies, the protection of sensitive areas and the sustainable use of agricultural land contribute to the maintenance of ecosystem services such as pollination, water filtration and erosion control.

In this perspective, this paper analyzes the main natural resources of Dumbrava commune – soil, water, vegetation, forests and biodiversity – identifies risk factors and proposes concrete measures for sustainable management. The application of these measures is essential for the conservation of resources, the prevention of environmental degradation and the promotion of a sustainable and resilient rural development model.

## MATERIALS AND METHODS

For the realization of these study, pedological, hydrogeological, climatic and vegetation cover data were used, obtained from official sources, local studies and field observations. Soil data included soil types, fertility, texture and chemical reaction, while hydrogeological information covered groundwater level and quality.

This approach allowed the identification of limiting factors, the assessment of the state of natural resources and the substantiation of the improvement and protection measures, necessary for the sustainable use of soils, waters and ecosystems in Dumbrava commune.

The object of study is the natural resources of Dumbrava commune, including soils, groundwater and surface waters, vegetation, forests and local biodiversity, as well as their interaction with anthropogenic activities. The study aims to identify the physico-chemical and ecological characteristics of the soils, the hydrogeological regime, the state of the vegetation cover and the diversity of species, in order to propose sustainable management measures that prevent the degradation of resources and ensure sustainable rural development.

## RESULTS AND DISCUSSIONS

Dumbrava commune is located in the eastern part of Timis County, 97 km away from Timisoara and 27 km from Lugoj, consisting of the villages of Bucovat, Dumbrava (residence) and Rachita.

The analysis of the natural conditions in Dumbrava commune, carried out on the basis of the geotechnical and hydrogeological study, allowed the identification of the main natural resources and the limitations associated with their use. The results obtained reflect the physico-geographical characteristics of the area and provide a scientific basis for establishing measures for sustainable management of soils, waters and agricultural land.

The pedological results highlight a great diversity of soils in Dumbrava commune, determined by the geological and morphological variation of the territory. The dominant soils are luvosols (47%), gleiosols (24%), planosols (15%) and eutricabosols (9%), complemented by alluvial soils and preluvosols on small areas. These data show that over 70% of the commune's surface is occupied by soils with medium to low fertility, affected by water stagnation and erosion processes.

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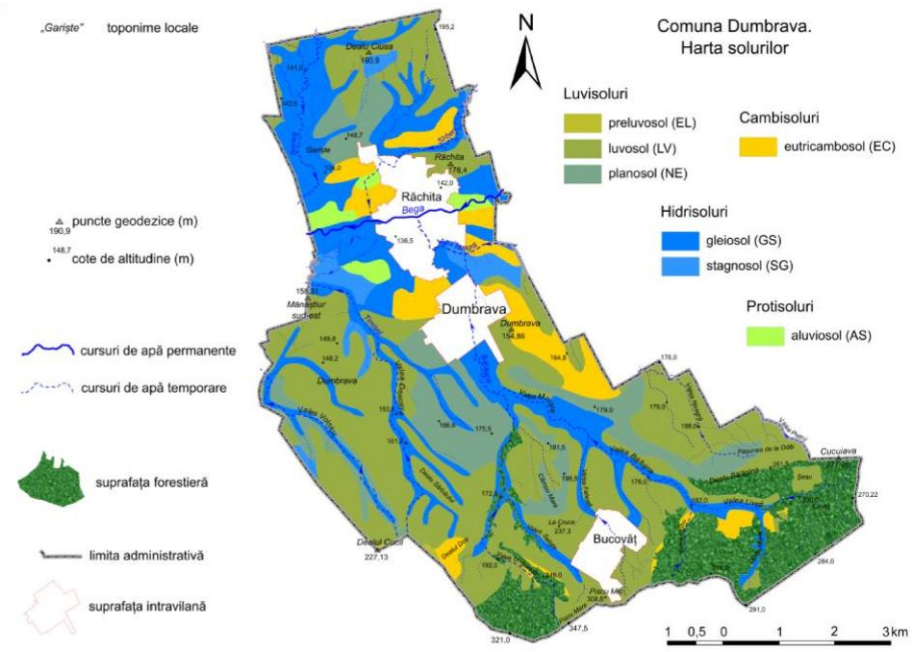


Figure 1. The Soil Map of Dumbrava

Luvosoils and planosoils, characteristic of hilly and glacial areas, show an acidic reaction (pH 5–6) and a reduced permeability in the lower horizons, which causes water accumulation and a decrease in soil aeration. On the other hand, the gleiosols, located in the Bega meadow, have a high humus content and good natural fertility, but are affected by excess humidity. These findings confirm the need to apply pedoameliorative measures adapted to each soil type: calcareous amendments for acidic soils, drainage and deep loosening works for compact soils, terraced on slopes and afforestation of areas at risk of erosion.

As for the texture of the soils, the middle classes (clay and sandy clay) predominate, which occupy over 90% of the surface at the level of the surface layer, but at depth the structure becomes finer (clayey), which affects the permeability and the aerohydric regime. This soil configuration requires the adaptation of agricultural work to prevent compaction and puddling of water, especially on flat or slightly sloping land.

The hydrogeological results show the existence of two main aquifer systems: groundwater and deepwater waters. The groundwater is located at depths between 0.5 and 10 m, depending on the relief and the nature of the soil. In the low areas of the commune (Bega meadow, Valea Bunea, Timișel), the hydrostatic level is between 0.5–2 m, favoring the stagnation of water on the surface and the appearance of glazing processes. On the other hand, in the glacis and hilly areas, groundwater is found at a depth of more than 10 m, with greater stability and a low risk of contamination. Deep waters, captured in sandy and stony deposits, are usually of good quality and can be used to feed households, but their renewal is slow, which requires prudent use.

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Discussions on water resources highlight a heightened dependence on rainfall and increased vulnerability during dry periods. At the same time, areas with high water tables face excess moisture, which limits agricultural production. These results indicate the need for a dual management strategy: controlled drainage and dewatering in wetlands, respectively conservation of water in the soil during dry periods through mulching, forest curtains and efficient irrigation systems.

*Table 1*

Distribution of the depth of the hydrostatic level (groundwater)

| **Depth class (relative to surface)** | **Occupied area (approx.)** | **Percentage of the commune's surface** |
|---|---|---|
| 0.5 – 1 m | 240 ha | 5% |
| 1 – 2 m | 1050 ha | 23% |
| 2 – 3 m | 150 ha | 4% |
| 3 -5 m | 130 ha | 3% |
| ➢ 10 m | 3000 ha | 65% |

The importance of protecting groundwater from diffuse pollution from the uncontrolled use of fertilisers and pesticides should also be stressed. Implementing environmentally friendly farming practices and plant buffer zones along watercourses can reduce the risk of contamination and help maintain aquifer quality.

The analysis of soil limiting factors highlighted three major processes: water erosion, pseudo-glaciation and glaciation. Erosion affects about 30% of the commune's surface, being more intense in the hilly area (Balasina Hill, Dos Hill). This limiting factor of the soil is expressed as a percentage per unit area: less than 5%; between 5-25%; between 25-50%; between 50-75% and over 75%.

At the level of Dumbrava Commune, this soil limiting factor has quite large effects, presenting the following intensities (*according to fig.2*):

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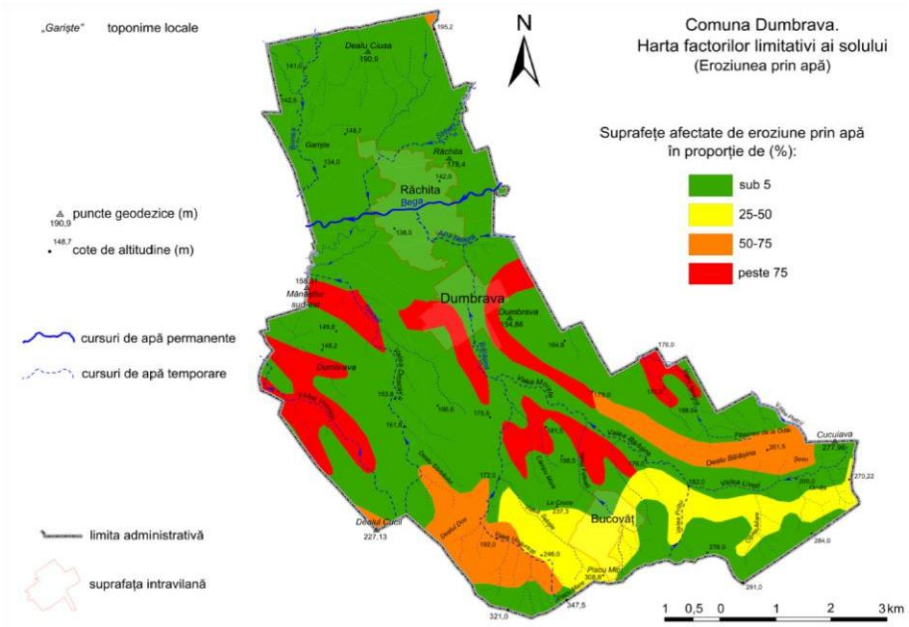


Figure 2. Map of soil limiting factors from Dumbrava

Stagno-gleyed processes are common in terraced glacis areas. At the level of Dumbrava Commune, this limiting factor of the soil affects a fairly large area, presenting the following intensity classes:

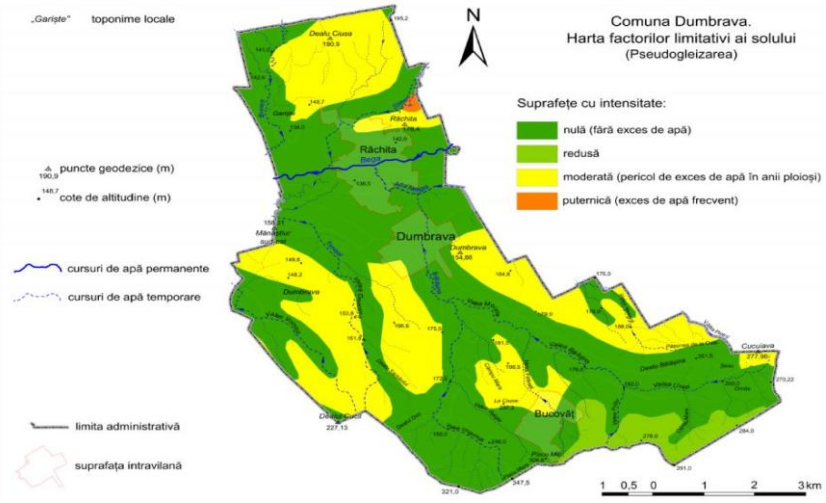


Figure 3. Map of soil limiting factors from Dumbrava

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The glazing processes occur in the Bega meadow and on the land with a high water table. These phenomena lead to a decrease in soil fertility and degradation of the agricultural landscape. At the level of Dumbrava Commune, this soil limiting factor affects a very small total area (about 190 ha, which represents about 4% of the commune's surface) and with very low intensities, presenting the following intensity classes (*according to fig. 4):*

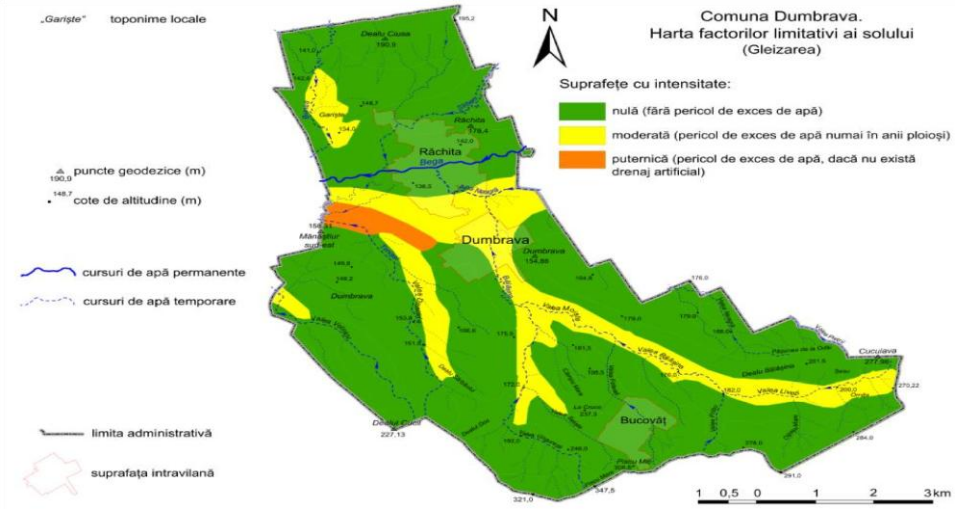


Figure 4. Map of soil limiting factors from Dumbrava

Discussions on these results underline the need for integrated land management, based on landscaping according to natural conditions. Measures such as carrying out agricultural works along contour lines, maintaining perennial vegetation on slopes and restoring meadow forests can significantly reduce the effects of these processes.

*Table 2*

Main limiting factors of the use of natural resources in Dumbrava commune

| **Resource category** | **Limiting factor** | **Main causes** | **Effects on the environment / agriculture** | **Improvement measures** |
|---|---|---|---|---|
| Soil | Water erosion | Unprotected slopes, improper agricultural works | Loss of fertile layer, decrease in production | Earthworks, grassy strips, afforestation |
| Soil | Glealization and pseudo-glelization | High water table, poor drainage | Water stagnation, low aeration, reduced fertility | Drainage, deep loosening, moisture-resistant crops |
| Soil | Acidification | Base washing, uncontrolled use of fertilizers | Decreased nutrient availability | Calcareous amendments , organic fertilizers |
| Water | High / low water table | Varied relief, uneven rainfall | Local floods / drought | Controlled dewatering, efficient irrigation |
| Land | Soil compaction | Use of heavy machinery | Reducing porosity, water stagnation | Traffic limitation, loosening works |
| Ecosystems | Reduction of natural | Extension of | Loss of biodiversity, | Reforestation, green |

| | | | | |
|---|---|---|---|---|
| | vegetation | agricultural land, deforestation | erosion | strips, forest curtains |

The results of the study confirm that the natural resources of Dumbrava commune – soil and water – are valuable, but vulnerable. Their sustainable use depends on the implementation of protection and restoration measures adapted to the local specificity. On a practical level, it is necessary to develop local ecological management programs, which include:

- monitoring soil and groundwater quality;
- drainage and erosion control works;
- promoting organic farming;
- restoration of forests and green areas.

By correlating these results with local development strategies, Dumbrava commune can evolve towards a sustainable rural development model, based on the balance between agricultural production, environmental protection and community well-being. The results thus provide a solid basis for long-term planning and for integrating sustainability principles into local public policies.

## CONCLUSIONS

The paper highlighted the close relationship between geological, pedological and hydrogeological conditions and the potential for land use. The analysis of the materials and methods allowed the identification of the main soil types – luvosols, gleiosols, planosols and eutricambosols – with medium fertility and sensitivity to erosion, glaciation and acidification processes.

The results showed that about a third of the surface is affected by soil degradation, and variations in the water table significantly influence the water regime of the soils. The discussions underlined the need to apply integrated protection measures: drainage, earthworks, afforestation and sustainable agricultural practices.

Overall, the commune of Dumbrava has valuable but fragile natural resources, whose rational use must be correlated with territorial planning and the principles of sustainable development, in order to ensure ecological balance and long-term economic viability.

## BIBLIOGRAPHY

DAVID GH., ȚĂRĂU D., ȘANDOR CI, NIȚĂ L, 2018, Soil and climate factors that define land productivity in the lower plain of Banat, Conference Proceedings Volume18, Issue: 3.2, Albena, Bulgaria,

DICU,D, R BERTICI, M HERBEI, F SALA, 2024, Variability of pastures based on soil quality indices., Applied Ecology & Environmental Research, vol 21, no. 6

DORNIK A., MARINELA ADRIANA CHEȚAN, DRĂGUȚ L., DICU D., ILIUȚĂ A., 2022, Optimal scaling of predictors for digital mapping of soil properties, Geoderma, Vol. 405, Elsevier

DORNIK ANDREI, MARINELA ADRIANA CHEȚAN, LUCIAN DRĂGUȚ, ANDREI ILIUȚĂ, DANIEL DORIN DICU, 2022, Importance of the mapping unit on the land suitability assessment for agriculture, Computers and Electronics in Agriculture, vol. 201, Ed. Elsevier

DUMITRU M., ȘTEFĂNESCU SL, 2000, Agri-environmental schemes in the context of rural development, Soil Science no. 2, vol. XXXIV, Ed. Signata, Timisoara,

MIHUȚ CASIANA, LUCIAN NIȚĂ, ANIȘOARA DUMA COPCEA, ALEXANDRU RINOVETZ, 2024 - Assessment of the productive capacity of agricultural lands for their sustainable use. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 24, Issue 1, 2024, Print ISSN 2284-7995, E-ISSN 2285-3952, pg. 619

MUNTEANU I., 2000, On some aspects regarding the relations between drought, pedogenesis and land degradation (desertification), Soil Science XXXIV, no. 2,

NITA L., TARAU D., ROGOBETE GH, NITA SIMONA, BERTICI R, TUTA SAS IOANA, SAS I, DICU D., 2018, The Role of Ecopedological Parameters in Management Sustainability of Banat Lands, Revista de Chimie, Vol. 69, no. 3

ROGOBETE GH., ȚĂRĂU D, ADIA GROZAV, BUZATU C., COVACI C., DICU DD,2021, Forest soils from Banat and southern Crișana, Ed. Eurobit Timisoara,

ROGOBETE GH., ȚĂRĂU, D., 1997 - Soils and their improvement. Banat soil map, Ed. Marineasa, Timisoara,

ȚĂRĂU D, ROGOBETE GH., NIȚĂ L., DICU D., CLARA TUDOR, RĂDUICĂ C., 2017, The role of pedologic information in defining land productivity in the mountain area of southern Banat, Soil Science.

ȚĂRĂU D., ROGOBETE GH., DICU D., 2016, Soils from western Romania, Characterization, Evaluation, Improvement, Ed., Eurobit Timisoara,

ȚĂRĂU D., ROGOBETE GH., DICU DD, ADIA GROZAV, NIȚĂ LD, ILIUȚĂ A.Ș., CLARA MAGDA TUDOR, BERTICI R., 2019, Lands and places between the Danube-Gugu-Crișu Negru Peak, Ed. Eurobit Timisoara,

TEACI D., 1980, Agricultural land reclamation, Ceres Publishing House, Bucharest,

VLAD H., M., 2009, Researches regarding the soils and the possibilities of restoring their fertility in Arad county, Doctoral Thesis, USAMVB, Timisoara.

*** OSPA Timis archive - Pedological and agrochemical studies,

*** SRTS-2012.

*** Methodology for elaborating pedological studies, vol. I, II and III, Agricultural Propaganda Editorial Office, Bucharest,