Annals of the University of Craiova - Agriculture, Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. 54/1/2024

INTEGRATED PEDOLOGICAL ASSESSMENT OF SOILS IN BAZOȘU VECHI (TIMIȘ-ROMANIA): FERTILITY, LIMITATIONS AND BREEDING DIRECTIONS

Marius Silviu STROIA[1], Casiana MIHUȚ[1], Anișoara DUMA-COPCEA[1], Veaceslav MAZĂRE[1], Ciprian STROIA[1] , Adalbert OKROS[1]

[1]University of Life Sciences "King Michael I" from Timisoara, Romania, Calea Aradului, 119, Timișoara, Romania

author email: mariusstroia76@yahoo.com

Corresponding author email: casiana_mihut@usvt.ro

Abstract

The paper presents a detailed analysis of the soil cover in Bazoșu Vechi locality, located in the north-west of Timiș County, with a focus on pedological properties, limiting factors of agricultural production and the potential for sustainable land use. Based on existing soil studies, the main soil types have been identified – alluvial, eutriosol, preluvosol, pelosols and stagnosols – each characterized by distinct morphological, physico-chemical and technological particularities. Of these, alluvial soils and eutrichabbosoils have a superior natural fertility and a high productive capacity, being suitable for a wide range of agricultural crops. In contrast, pelosols and stagnosols show important pedological limitations, determined by the fine texture, low permeability, defective aerohydrous regime and low humus level, and complex agro-pedo-ameliorative interventions are recommended. The results obtained highlight the importance of detailed knowledge of soil properties and pedoclimatic conditions in order to adopt appropriate measures to preserve fertility, optimize agricultural practices and prevent land degradation. The study contributes to the substantiation of modern solutions for the sustainable management of soil resources in the context of intensified agriculture in Timiș County.

Keywords: agricultural production, Bazoșu Vechi, fertility, limiting factors, soil conservation

INTRODUCTION

The detailed knowledge of soil properties, limiting factors and pedogenetic processes is the foundation for the development of sustainable agriculture, especially in regions with high agricultural potential, such as the north-west of Timiș County. Soil, an essential component of the ecosphere, has a number of essential functions – biomass production, water filtration and storage, nutrient recycling and ecosystem support – functions that can be affected by climate change, intensification of agricultural work or inappropriate use of resources (Günal et al., 2015; Panagos et al., 2015).

At European level, soils are subject to increasingly accentuated degradation processes, caused by erosion, loss of organic carbon, compaction or acidification, phenomena highlighted by recent research on soil dynamics and the evaluation of their functions in agriculture (Cerdan et al., 2010; Yigini & Panagos, 2016; Paz et al., 2024). In Central and South-Eastern Europe, soil pressures are associated with both increased land use and climate change, which affects water balance and land productive capacity (Günal et al., 2015).

In Romania, numerous studies have demonstrated the direct relationship between local soil peculiarities and agricultural potential, emphasizing the importance of permanent monitoring of soil condition (Dumitru et al., 2011; Munteanu et al., 2005). The analyses carried out in different areas of the country have highlighted important variations in

terms of texture, structure, degree of saturation in the bases, humus content and aerowater regime, all influencing the production capacity (Păltineanu et al., 2007; Vintilă et al., 2015).

In Timiș County, the soils have a high diversity, determined by the geological, climatic and hydrological particularities of the area. Studies carried out in the neighboring territories confirm the presence of soil types similar to those in Bazoșu Vechi, namely alluvial, eutriosol, preluvosol, as well as soils with low fertility such as stagnosols and pelosols (Dologa et al., 2013; Dicu et al., 2019; David et al., 2020). Other local research highlights the role of climatic factors in soil evolution, as well as the importance of aerohydric regime and nutrient supply in maintaining fertility (Marchiș et al., 2018; Sopca et al., 2018).

Also, the use of modern technologies, such as satellite image analysis and the integration of spatial databases, has allowed the detailed characterization of territorial variability, providing support for soil assessments at local scale (Popescu et al., 2020; Svestac et al., 2020). Studies carried out in proximity, such as those in Sânpetru Mare, Dudeştii Vechi or Remetea Mare, confirm the presence of a similar soil structure and comparable limiting factors, especially those related to fine texture, poor drainage or soil acidity (Gavra et al., 2019; Niță et al., 2011; Mihuț et al., 2022, 2023).

In this area, agriculture is the dominant economic sector, and the capitalization of the productive potential of the soils depends directly on the way of land use, the correct application of agro-improvement works and fertility conservation strategies (Țărău et al., 2014). Limiting factors, such as excess water, reduced permeability, compaction, acidity or insufficient humus supply, significantly influence land productivity, requiring interventions adapted to the soil type (Mihuț et al., 2022).

In this context, the present paper aims to characterize in detail the soil types in Bazoșu Vechi, to identify the limiting factors and to offer solutions for soil improvement and conservation, in accordance with the requirements of sustainable agriculture. The study plays an important role in guiding local agricultural practices, facilitating effective management of soil resources and helping to establish appropriate measures to maintain long-term fertility.

MATERIALS AND METHODS

The study was carried out in Bazoșu Vechi locality, located in the north-west of Timiș County, a territory characterized by a pedological diversity determined by the specific geological, morphological and climatic conditions. The methodological approach was based on the integrated analysis of soil resources, using both existing pedological data and information from the specialized literature regarding the soils in the Banat plain area.

1. Delimitation and characterization of the study area

The analyzed area falls within the north-western sector of the Tisa Plain, a territory with low altitudes, predominantly flat relief and climatic conditions specific to the forest-steppe. The climatic data used were taken from works carried out in the neighboring territories (Păltineanu et al., 2007; Marchiș et al., 2018), being relevant for the assessment of the hydro-thermal regime of soils.

2. Types of soil analysed

The pedological evaluation aimed to identify the main soil types characteristic of the area: Alluvial, Eutricambosols, Preluvosols, Pelosols and Stagnosols.

For each type of soil, the morphological, physical and chemical properties described in the national reference works on Romanian pedology were analyzed (Dumitru et al., 2011; Munteanu et al., 2005), as well as the pedogenetic characteristics highlighted in regional studies (Dologa et al., 2013; Dicu et al., 2019).

3. Soil analysis methods

The characterization of the soils was carried out by:

The study of soil profiles, according to the SRTS methodology (Florea & Munteanu, 2012), taking into account the horizontality, color, structure and texture.

Physico-chemical analyses, based on previously published data and descriptions for similar territories in Timiș County, which include: humus content, degree of saturation in bases, pH (acid-basicity), cation exchange capacity (T), dominant texture, aerohydric regime

the level of nutrient supply.

Identification of limiting factors, according to the ICPA methodology and the specific literature (Țărău et al., 2014; Mihuț et al., 2022), highlighting the limitations generated by reduced permeability, excess water, soil reaction, particle size composition or humus level.

4. Methods of interpretation and classification

The data analysis was carried out by:

Classification of soils in the Romanian Soil Taxonomy System (SRTS-2012).

Comparison with regional data from pedological studies carried out in nearby localities (Sânpetru Mare, Dudeştii Vechi, Remetea Mare, Șag, Livezile, etc.), to validate the characteristics and limiting factors.

Assessment of natural fertility and establishment of agro-pedo-ameliorative recommendations for each soil type, based on the criteria used by the ICPA and recent scientific works (Mihuț et al., 2023; Paz et al., 2024).

RESULTS AND DISCUSSIONS

1. General characteristics of the soils identified in Bazoșu Vechi

Based on pedological data and specialized literature, five main types of soil have been identified in the Bazoșu Vechi area. Their properties are summarized in the table below (Table 1).

Table 1.

Main soil types and key physical–chemical properties in Bazoșu Vechi

Soil Type	Texture	Humus Content	Drainage	pH	Natural Fertility	Agricultural Suitability
Alluviosol	loamy / clay-loam	medium	good–moderate	neutral–slightly alkaline	high	cereals, sunflower, vegetables, pasture
Eutricambosol	loam / silty-loam	medium	good	neutral	high	almost all field crops
Preluvosol	clay-loam	2–3%	moderate	6.0–7.0	medium–high	cereals, technical crops, orchards/vineyards on slopes
Pelosol	heavy clay	low	poor	neutral–slightly alkaline	low	limited; cereals & fodder crops
Stagnosol	clay / silty-clay	very low	very poor	acidic–moderately acidic	very low	marginal pasture, restricted cropping

The results confirm that the soils of Bazoșu Vechi are extremely heterogeneous in terms of natural fertility. Alluvial soils and eutricbosols stand out for their favorable physicochemical properties, stable structure and adequate aerohydric regime, characteristics also reported in other regional studies (Dicu et al., 2019; Mihuț et al., 2022). The preluvosoils have a good fertility, but are influenced by the variability of rainfall, an aspect also highlighted by Păltineanu et al. (2007).

Pelosoils and stagnosoils are soils with low fertility, affected by excess water, low permeability and a low humus content, a fact also described by Țărău et al. (2014) in the regional works on the heavy soils of Banat.

2. Main limiting factors identified (Table 2).

Table 2.

Limiting factors of soil productivity in the study area

Soil Type	Limiting Factors	Degree of Limitation	Notes
Alluviosol	textural variation, occasional flooding	low	productive; requires anti-erosion measures in some areas
Eutricambosol	slight slope or compaction risk	low–moderate	highly productive under correct management
Preluvosol	waterlogging in spring; drought in summer	moderate	improved by drainage + irrigation
Pelosol	heavy texture, low permeability, poor aeration	high	requires deep loosening, organic amendments
Stagnosol	permanent/seasonal stagnation of water, acidity	very high	requires drainage, subsoiling, liming

The major limiting factors are associated with the fine texture and poor water regime of pelosols and stagnosols. Heavy soils have a poor structure, low air diffusion and

susceptibility to compaction, an aspect also highlighted in the European literature (Günal et al., 2015; Panagos et al., 2015). Under these conditions, agricultural productivity is severely affected, and ameliorative interventions become essential.

2.Comparative productive capacity of soils

To visualize the major differences between soil types, the following graph is shown (Figure 1).

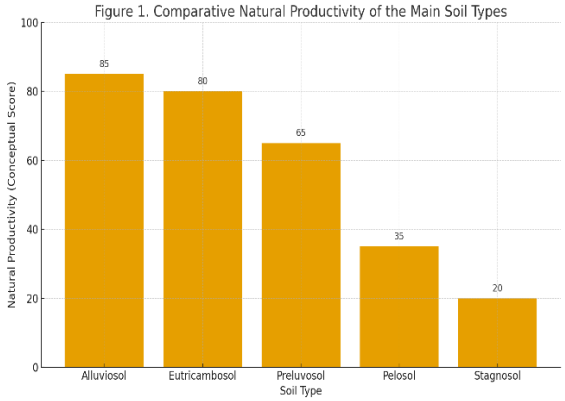

Figure 1. Comparative natural productivity of the main soil types

Alluvial and eutricambosols have the highest productive capacity, due to their balanced texture and good supply of nutrients, in line with the observations of Niță et al. (2011) and Mihuț et al. (2023). Preluvosols offer medium to high potential, but they are highly dependent on the rainfall regime, being vulnerable to drought. In contrast, pelosols and stagnosols have minimum values of productive capacity, requiring costly improvement interventions.

3.Agro-pedo-ameliorative recommendations

Table 3.
Recommended improvement measures for each soil type

Soil Type	Recommended Measures	Expected Effect
Alluviosol	levees, crop rotation, organic fertilization	improved stability and nutrient cycling
Eutricambosol	erosion protection, balanced fertilization	maintains high fertility
Preluvosol	surface drainage, irrigation, mulching	improved moisture regime
Pelosol	deep loosening, subsoiling, organic matter addition	improved aeration and structure
Stagnosol	drainage systems, subsoiling, liming	reduces water stagnation; improves pH

The proposed recommendations coincide with those highlighted in the national and international literature, where interventions on poorly drained soils are essential for fertility recovery (Paz et al., 2024). For heavy soils (pelosol and stagnosol), the application of organic fertilizers, loosening and installation of drainage systems are mandatory measures to increase productivity

CONCLUSIONS

The study on the soil cover in Bazoșu Vechi highlights a significant pedological diversity, determined by the complex interaction between the climatic, geomorphological and hydrological factors characteristic of the north-west of Timiș County. The analysis carried out allowed the identification of the main soil types – alluvial, eutricbosols, preluvosols, pelosols and stagnosols – each presenting particularities that directly influence the productive capacity and agricultural use of the land.

The alluvial and eutricbosols are distinguished by high natural fertility, favorable aerowater regime and a wide range of suitable crops, contributing to the superior agricultural potential of the area. Preluvosoils have a medium to high fertility, but are strongly influenced by seasonal climatic variability, which requires interventions to regulate the humidity regime. On the other hand, pelosols and stagnosols are characterized by a low level of humus, poor drainage, low permeability and an unstable structure, situations that severely limit productions and require complex breeding measures.

The results obtained confirm the central importance of detailed knowledge of soil properties in the agricultural planning process. The implementation of agro-pedo-ameliorative measures, such as drainage works, deep loosening, the application of

organic and mineral fertilizers or the choice of technologies adapted to each type of soil, are essential elements for maintaining and increasing fertility.

The study also highlights the need for sustainable agricultural practices aimed at conserving land resources and reducing the risks of degradation. With increasing anthropogenic pressures and increased climate variability, the adoption of proactive soil management strategies becomes crucial to make the most of the area's agricultural potential.

Overall, the research contributes to strengthening the knowledge base on soils in Bazoșu Vechi and provides a useful tool for decision-makers, specialists and farmers to guide agricultural production processes, land use planning and the application of effective measures to preserve soil fertility.

REFERENCES

Cerdan, O., Govers, G., Le Bissonnais, Y., Van Oost, K., Poesen, J., Saby, N., Dostal, T. (2010). Rates and spatial variations of soil erosion in Europe: A study based on erosion plot data. *Geomorphology*, 122(1–2), 167–177.

David, S. F., Mateoc-Sîrb, N., Mateoc, T., Bacău, C., Copcea, A. D., Mihuț, C. (2020). Agricultura și utilizarea durabilă a solului în județul Timiș, România.

Dicu, D., Țărau, D., Rogobete, G., Bertici, R., Niță, L., Ienciu, A., Fota, O. (2019). Soil fund structure and soil quality in the middle and lower basin of the Timiș River, Romania. *Research Journal of Agricultural Science*, 55(1).

Dologa, D., Dicu, D., Iliuță, A. (2013). Factori pedologici și particularități zonale ale județului Timiș.

Dumitru, M., Manea, A., Ciobanu, C., Dumitru, S., Vrînceanu, N., Calciu, I., Eftene, M. (2011). *Monitoring the quality status of soils in Romania*. ICPA București, Editura SITECH.

Gavra, A., Bojinescu, F.-N., Mihuț, C., Okros, A., Duma-Copcea, A. (2019). Genesis conditions of the soil cover in Sânpetru Mare, Timiș County, Romania.

Günal, H., Korucu, T., Birkas, M., Özgöz, E., Halbac-Cotoara-Zamfir, R. (2015). Threats to sustainability of soil functions in Central and Southeast Europe. *Sustainability*, 7(2), 2161–2188.

Marchiș, I., Sopca, I., Perescu, R., Mihuț, C., Mircov, V. D. (2018). Role of climatic factors in the genesis of soil resources in Livezile, Timiș County, Romania.

Mihai, B., Săvulescu, I., Sandric, I. (2007). Change detection analysis (1986–2002) in Romania's vegetation cover. *Mountain Research and Development*, 27(3), 250–258.

Mihuț, C., Mateoc-Sîrb, N., Copcea, A. D., Niță, L., Ciolac, V., Okros, A. A., Popa, D. (2022). Assessment of soil quality limiting factors. Case study: Secaș, Timiș county, Romania. *Scientific Papers Series – Management, Economic Engineering in Agriculture and Rural Development*, 22(1), 413–419.

Mihuț, C., Mateoc-Sîrb, N., Duma-Copcea, A., Niță, S., Lațo, I., Ciolac, V., Okros, A. (2023). Assessing soil fertility for sustainable agriculture in Remetea Mare, Timiș County, Romania. *Scientific Papers Series – Management, Economic Engineering in Agriculture & Rural Development*, 23(2).

Munteanu, I., Dumitru, M., Florea, N., Canarache, A., Lăcătușu, R., Vlad, V., Roșu, C. (2005). Soil mapping, monitoring and database compilation in Romania at the beginning of the 21st century. *Soil Resources of Europe*, 20559, 281–296.

Niță, L., Mihuț, C., Lață, K., Niță, S. (2011). Identification and characterization of soil resources in Dudeștii Vechi, Timiș County. *Research Journal of Agricultural Science*, 43(3), 146–149.

Okros, A., Niță, S., Mihuț, C., Niță, L. D., Duma-Copcea, A., Boldea, M. (2012). The agricultural system in Beba Veche, Timiș County.

Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., Lugato, E., Meusburger, K., Alewell, C. (2015). The new assessment of soil loss by water erosion in Europe. *Environmental Science & Policy*, 54, 438–447.

Păltineanu, C., Mihăilescu, I. F., Seceleanu, I., Dragotă, C., Vasenciuc, F. (2007). Aridity indices for describing present climate and soil conditions in Eastern Europe: A Romanian case study. *Theoretical and Applied Climatology*, 90(3), 263–274.

Paz, A. M., Castanheira, N., Miloczki, J., Carrasco, M., Vicente, C., Carranca, C., Chenu, C. (2024). Accumulated knowledge on the impact of agricultural soil management practices in Europe. *European Journal of Soil Science*, 75(2), e13468.

Popa, R. G., Șchiopu, E. C., Bălăcescu, A., Popescu, L. G., Pătrașcu, A. (2023). Soil sustainability assessment using the LUCAS database in the South-West region of Romania. *Sustainability*, 15(11), 8513.

Popescu, C. A., Herbei, M. V., Sala, F. (2020). Remote sensing in analysing spatial variability of land surfaces: A case study in Timiș County, Romania.

Sopca, I., Perescu, R., Marchiș, I., Mihuț, C., Mircov, V. D. (2018). Pedoclimatic conditions for soil genesis in Șag, Timiș County, Romania.

Svestac, C., Herbei, M. V., Sala, F. (2020). Land cover change detection in Timiș County using Corine Land Cover datasets (1990–2018).

Tóth, G., Antofie, T. E., Jones, A., Apostol, B. (2016). LUCAS topsoil survey 2012 and derived properties for croplands and grasslands in Bulgaria and Romania. *Environmental Engineering & Management Journal*, 15(12).

Țărău, D., Dicu, D., Rogobete, G., Marinca, C., Țărău, A. (2014). The role of pedological information in defining land productivity and pressures on soil quality in Timiș County.

Vintilă, R., Balotă, O.-L., Vișan, A. N., Voicu, P. (2015). Contribution to producing a map of organic carbon content in Romanian topsoil, according to the Global Soil Map initiative. *SGEM Conference Proceedings*, 2(2), 771–778