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PEDOLOGICAL AND AGROCHEMICAL CHARACTERIZATION OF LANDS WITH PASTURES FROM CARANSEBES

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Abstract *This study presents a comprehensive soil characterization and analysis of the main limiting factors affecting pasture lands in the Caransebeș area. The research aims to evaluate the physical, chemical, and agrochemical properties of soils in order to identify constraints that influence pasture productivity and sustainable land use. Soil samples were collected from representative pasture sites and analyzed for texture, pH, organic matter content, nutrient availability and soil compaction. In addition, environmental and management-related factors such as slope, drainage conditions, erosion risk, and grazing intensity were assessed. The results indicate that the dominant soils are moderately to poorly fertile, with limitations related to soil acidity, low organic matter content, nutrient deficiencies, and uneven water availability. In some areas, soil compaction and erosion caused by improper grazing practices further reduce pasture quality and biomass production. These limiting factors negatively affect plant diversity, forage yield, and long-term soil health. The study highlights the importance of implementing appropriate soil management measures, including liming, organic amendments, controlled grazing, and erosion control practices, to improve pasture productivity. The findings provide valuable information for land managers and local authorities, supporting sustainable pasture management and contributing to the preservation of soil resources in the Caransebeș region. This research emphasizes the role of soil assessment as a fundamental tool for optimizing pasture use and enhancing agricultural sustainability.*

Keywords*: soil, pastures, Caransebes, agrochemical, pedological*

INTRODUCTION

Pasture lands represent an essential component of agricultural systems, providing a primary source of forage for livestock and contributing to rural economies and environmental stability. The productivity and sustainability of pastures are strongly influenced by soil properties, which determine water availability, nutrient supply, and the development of plant communities. A detailed understanding of soil characteristics is therefore fundamental for identifying constraints that limit pasture performance and for designing appropriate land management strategies.

In the Caransebeș area, pastures occupy significant surfaces and play an important role in supporting animal husbandry. However, these lands are often affected by natural and anthropogenic factors that reduce their productive potential. Soil degradation processes such as acidification, nutrient depletion, compaction, and erosion, combined with inadequate grazing management, can lead to reduced forage yield, lower biodiversity, and declining soil quality. Climatic variability and topographic conditions further intensify these limitations, increasing the vulnerability of pasture ecosystems.

Soil characterization provides essential information on physical, chemical, and agrochemical parameters, enabling the identification of limiting factors that affect pasture growth and sustainability. By analyzing soil texture, structure, reaction, organic matter content, and nutrient status, it is possible to assess soil fertility and resilience. Moreover, understanding

the interaction between soil properties and land use practices supports the development of effective measures for soil conservation and pasture improvement.

The aim of this study is to characterize the soils of pasture lands in the Caransebeș region and to identify the main limiting factors influencing their productivity. The results are intended to support sustainable pasture management and informed decision-making at the local level.

MATERIALS AND METHODS

The study was conducted on pasture lands located in the Caransebeș area, situated in the southwestern part of Romania. The selected sites are representative of the main soil types, relief forms, and management practices specific to the region. Field investigations and laboratory analyzes were carried out to characterize soil properties and to identify the main factors limiting pasture productivity.

Soil sampling was performed during the vegetation period. Representative soil profiles were opened, and soil samples were collected from these profiles. In each sampling site, composite samples were obtained by mixing several subsamples to ensure homogeneity and reliability of the results.

Laboratory analyzes were conducted using standard methods. Soil texture was determined by the pipette or hydrometer method, while soil pH was measured potentiometrically in a soil–water suspension.

Available nitrogen, phosphorus, and potassium were analyzed using established agrochemical procedures. Bulk density and soil compaction were evaluated to assess physical constraints affecting root development and water infiltration.

In addition to soil analyses, field observations were carried out to evaluate topography, drainage conditions, erosion risk, and grazing intensity. Vegetation cover and pasture condition were visually assessed. The collected data were analyzed and interpreted in relation to pasture productivity, allowing the identification of key limiting factors and the formulation of recommendations for sustainable pasture management in the Caransebeș area.

RESULTS AND DISCUSSION

The municipality of Caransebeș, located in the southwestern part of Romania in Caras-Severin County, is located at the contact between the mountainous area of the Tarcu Mountains and the Semenic Caransebes Depression, at an average altitude of approximately 280 meters.

The relief is predominantly depressional, consisting of meadows, terraces and gentle hills, crossed by the Timiș River and its tributaries, which contribute to the formation of fertile alluvial plains. To the east and southeast, the relief gradually rises towards the mountain peaks, reaching altitudes of over 2000 m in the Tarcu Mountains, and to the west and southwest, more gentle relief forms specific to the hilly area appear. This diversity of relief forms also determines a variety of landscapes from agricultural fields to beech and coniferous forests in the mountainous areas.

The climate is temperate-moderate continental with sub-Mediterranean influences, which translates into very warm, but not excessively hot, summers and relatively mild winters. The soils of Caransebes are varied depending on the relief. In the meadows and lower terraces of the rivers, alluvial soils predominate, rich in organic matter and favorable for agricultural crops, while on the hills and slopes, brown and podzolic soils are found, thinner and poorer in

humus, prone to erosion. In the mountainous areas, the soils are skeletal, mostly covered by forests that have a protective role against land degradation.

This combination of varied relief, mild climate and different types of soils gives the Caransebes region a high agricultural and tourist potential, making this area one of the most complex and balanced from a natural point of view in the Banat Montan.

The Caransebeș Depression presents an alternation of hilly relief forms and terraces of the Timiș River. Its position in the southwestern part of the country places it under the influence of the temperate-continental climate with Mediterranean nuances, specific to Banat, influenced by air masses from the Adriatic Sea and protected by the Carpathian Mountains. This climate is thermally balanced and favorable for the practice of agriculture.

Microrelief forms have had a decisive influence on the degree of soil development. In areas with stable natural relief, soils have reached an advanced stage of evolution, characterized by zonal maturity. On the other hand, in the Timiș River floodplain, frequent overflows have favored the accumulation of alluvial sediments, leading to the formation of alluvial soils, of which psamic and gleyic soils are predominant in the vicinity of the riverbed. In more remote areas, eutricambosols and districambosols with variable levels of gleyization appear.

In the urban area of Caransebeș, the distribution of land use is relatively balanced. Arable land occupies approximately 35% of the total, hayfields extend over 25%, and pastures and forests each represent 15%. Orchards and vineyards each represent 5% of the administrative area.

The soils in this region are the result of a complex formation process, based on a series of interdependent pedogenetic factors: climate, relief, nature of rocks, vegetation and the presence of groundwater. Any of these factors can significantly influence the local pedological characteristics, contributing to the typological diversity of the soils.

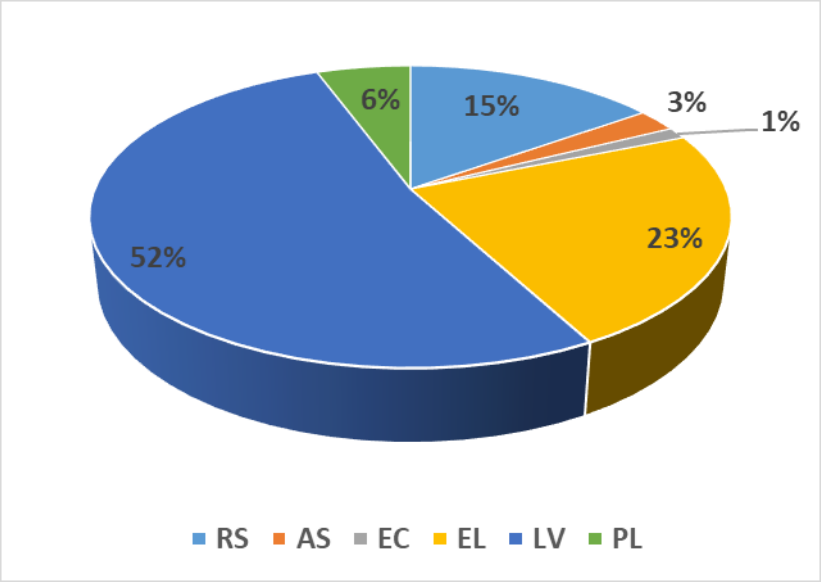

Figure 1. Soil types from Caransebes pasture land

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The classification of pasture lands in the Caransebeș area is based on pedological assessment, taking into account soil properties, relief conditions, water regime and degradation status, as well as the potential for fodder production. According to the evaluation system used in Romania, pasture lands fall into five quality classes, presented in Figure 2.

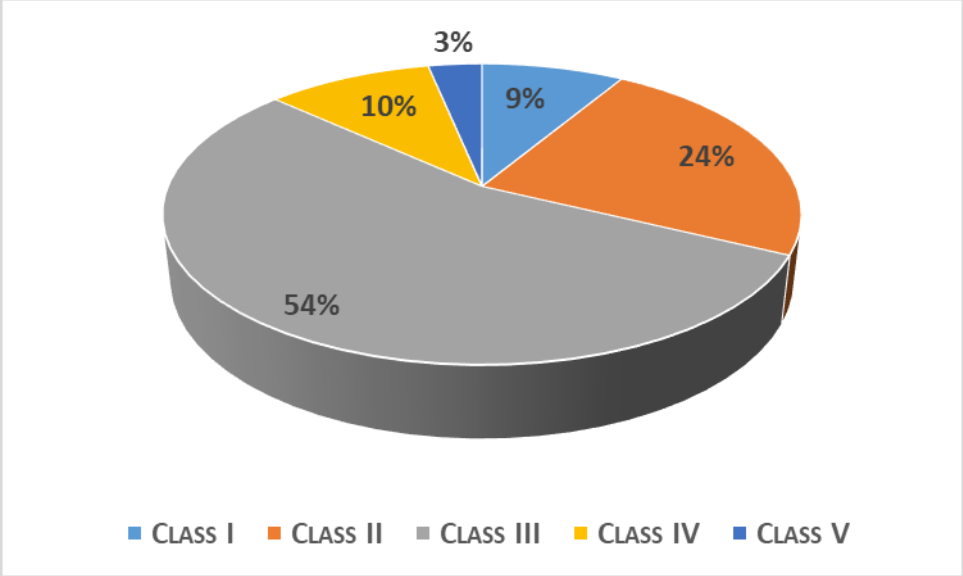

Figure 2. Quality classes of pasture lands in Caransebes

The pastures in the Caransebeș area are developed on a diverse pedological background, determined by the geomorphological conditions of the depression and the neighboring hilly units. The pedological analysis highlights the predominance of soils with medium natural fertility, used extensively for grazing.

The most representative soils identified on these lands are represented by:

1. Stagnant Luvic soil, extremely deep, dusty clay/dusty sandy clay (EL st 43/34) with the folowing characteristics:
   - the texture is dusty clay between 0-37 cm, dusty clayey clay between 37-100 cm and dusty sandy clay between 100-160 cm;
   - total porosity is high between 0-37 cm and low between 37-100 cm;
   - apparent density is low between 0-37 cm and high between 37-10 cm;
   - the wilting coefficient is medium between 0-100 cm;
   - The field capacity is medium between 0-100 cm.
   - the soil reaction is moderately acidic between 0-100 cm and weakly acidic between 100-160 cm;
   - the humus reserve in the first 50 cm is small;
   - the nitrogen index is low between 0-50 cm.

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Table 1

Physical and chemical characteristics of stagnant luvic soil from Caransebes

Horizons	MU	**At**	**Aow$_2$**	**ABw$_2$**	**Btw$_4$**	**Btw$_5$**	**BC**	**C**
Depth	cm	7	19	37	55	100	120	160
Coarse sand (2.0 - 0.2 mm)	%	7.3	7.1	8.5	7.1	5.8	7	7.7
Fine sand (0.2 –0.02 mm)	%	32.3	29.6	24.7	22.5	19.3	37.3	32.8
Dust (0.02 – 0.002 mm)	%	35.6	37.2	37.3	35.7	32.9	37.5	42.8
Colloidal clay (under 0.002 mm)	%	24.8	26.1	29.5	34.7	42	18.2	16.7
Physical clay (below 0.01 mm)	%	43.6	46.2	49.8	53.9	58.9	46.4	44.4
TEXTURE		LP	LP	LP	TP	TP	SS	SS
Specific density (Ds)	g/cm$_3$	2.57	2.61	2.65	2.68	2.7		
Apparent density (Yes)	g/cm$_3$	1.22	1.24	1.34	1.52	1.5		
Total porosity (PT)	%	52.53	52.49	49.43	43.28	44.44		
Aeration porosity (PA)	%	23.49	23.23	17.81	8.32	8.44		
Degree of settlement (GT)	%	-7.11	-6.57	0.75	14.55	14.28		
Hygroscopicity coefficient (CH)	%	5.82	6.12	6.92	8.13	9.83		
Wilting coefficient (CO)	%	8.73	9.19	10.38	12.20	14.75		
Field capacity (CC)	%	23.8	23.6	23.6	23	24		
Total capacity (CT)	%	43.06	42.33	36.89	28.48	29.63		
Useful water capacity (CU)	%	15.07	14.42	13.23	10.81	9.25		
Hydraulic conductivity (K)	mm/h	10	7	3.5	0.9	0.7		
pH -in water	united.	5.38	5.39	5.43	5.48	5.5	5.9	6.01
Calcium carbonates	%							
Humus	%	2.29	1.63	1.08	0.64			
Nitrogen Index (NI)		1.00	0.81	0.51	0.34			
Humus reserve	t/ha	19.56	24.25	26.05	12.65		82.51	
Mobile phosphorus (mobile P)	ppm	13.14	19.14					
Mobile potassium (mobile K)	ppm	70	53					
Exchange Bases (SB)	me/100	6.5	6.9	6.5	8.1	11.3	17.7	17.9
H changeable (SH)	me/100	8.35	7.05	7.15	7.35	6.95	5.9	5.5
Cationic sch cap (T)	me/100	14.85	13.95	13.65	15.45	18.25	23.6	23.4
Degree of saturation in bases (V)	%	43.77	49.46	47.61	52.42	61.91	75	76.43

2. Vertic-stagnic Luvosol, strongly stagnogleyized, extremely deep, medium sandy loam/loamy clay (LV vs-st W4 32/61) with the folowing characteristics:

- the texture is medium sandy loam between 0-35 cm, medium clay between 35-93 cm and loamy clay between 93-150 cm;
- total porosity is medium between 0-93 cm;
- apparent density is medium between 0-35 cm and high between 35-93 cm;
- the wilting coefficient is low between 0-53 cm and medium between 53-93 cm;
- The field capacity is small between 0-35 cm and large between 35-93 cm.
- the soil reaction is moderately acidic between 0-93 cm and weakly acidic between 93-150 cm;
- the humus reserve in the first 50 cm is medium;
- the nitrogen index is medium between 0-53 cm.

Table 2

Physical and chemical characteristics of vertic-stagnic Luvosol from Caransebes

HORIZONS	MU	**At**	**Elw_3**	**Elw_4**	**E/Byw_5**	**$Btyw_5$**	**$BCyw_4$**
Depth	cm	0-7	-35	-53	-93	-120	-150
Coarse sand (2.0 – 0.2 mm)	%	26.4	22.5	19.8	18.6	7.2	3.1
Fine sand (0.2 – 0.02)	%	40.4	43.3	37.3	30.5	22.7	18.7
Dust (0.02-0.002 mm)	%	19.2	19.9	17.0	19.7	23.1	24.6
Colloidal clay (below 0.002)	%	14.0	14.3	25.5	31.2	50.5	53.6
Physical clay (powder II + arg col)	%	24.4	25.3	35.0	40.6	62.8	67.4
TEXTURE		SM	SM	LL	LL	AL	AL
Specific density (Ds)	g/cm3	2.68	2.70	3.72	2.78		
Apparent density (Da)	g/cm3	1.45	1.60	1.58	1.57		
Total porosity (Pt)	%	45.90	40.74	41.51	42.27		
Aeration porosity (Pa)	%	21.40	13.22	-3.11	-11.40		
Degree of settlement (Gt)	%	2.93	13.92	14.73	15.59		
Hygroscopicity coefficient (CH)	%	3.3	3.31	5.98	11.31		
Wilting coefficient (CO)	%	4.95	5.06	8.97	10.97		
Field capacity (CC)	%	16.88	17.19	28.49	34.25		
Total capacity (CT)	%	31.65	25.46	26.52	26.93		
Useful water capacity (CU)	%	11.93	12.14	19.52	23.48		
Hydraulic conductivity	mm/h	17.0	14.0	1.4	0.9		
pH in water		5.33	5.37	5.29	5.43	6.36	6.51
Carbonates ($CaCO_3$)	%	-	-	-	-	-	-
Humus	%	2.42	1.82	0.92	0.92		
Mobile phone	ppm	14.0	6.0	4.0			
K mobile	ppm	68	44	32			
Exchange Bases (SB)	me/100	18.26	15.41	17.56	15.83	11.50	10.58
H changeable (SH)	me/100	508	3.24	3.70	2.72	2.37	2.02
Cationic sch cap (T)	me/100	23.34	22.65	21.26	18.55	14.27	13.00
Base saturation gr (VAh)	%	78.23	85.69	82.59	85.33	83.39	84.46
RH	%	52.65	52.42	21.81	0	RHE	133.88
P min		47.38	47.33	49.15	50.08		
Mobile aluminum	me/100	1.01	1.11	0.32	0.96		
Soluble salts	(1:5) (%	5.53	5.72	2.16	2.91		

The main limiting factors that decrease the quality of the soil cover are measured in particular by acidity (very severe on 10% of the surface, moderate 47%), reduced humus reserve (severe 3%, moderate 47%), compaction (severe 2%. moderate 58%>), erosion and landslides (very severe 8.4%. severe 5.6%), moderate 4.9%), deep erosion (very severe 4.6%) and overflow flooding (very severe 3.2%, severe 3%>).

The agrochemical characterization of soils under permanent pastures in the Caransebeș area highlights key fertility indicators that condition both the productivity and sustainability of grassland ecosystems.

Soil reaction (pH)It is generally moderately acidic, the weighted average pH value being 5.28. Analyzing the soil reaction by assessment intervals, it is found that on an area of 452.92 ha (99.75 %) the soil reaction is moderately acidic, and on an area of 1.13 ha (0.25 %) the soil reaction is weakly acidic.

The recommended doses of amendments for correcting the acidic reaction of the soil are between 4.4 and 8.1 t/ha. The total amount of amendments required is 2900 tons, which will be applied on an area of 452.92 ha.

Phosphorus supply of the soils is generally poor, the weighted average of the phosphorus content being 9.8 ppm P. Thus, on an area of 237.72 ha (52.36 %) the phosphorus supply is very poor, on an area of 204.20 ha (44.97 %) the phosphorus supply is poor and on 12.13 ha (2.67 %) the phosphorus supply is medium.

Potassium supply of the soils is poor, the weighted average of the potassium content being 66 ppm K. Thus, on an area of 274.35 ha (60.42 %) the potassium supply is poor, on 178.57 ha (39.33 %) the potassium supply is average, and on 1.13 ha (0.25 %) the potassium supply is very good.

Humus insurance of the soils is generally medium, the weighted average of the content being 2.51%. Therefore, on an area of 66.26 ha (14.59 %) the humus supply is poor, on an area of 361.03 ha (79.51 %) the humus supply is medium, on an area of 25.63 ha (5.64 %) the humus supply is good and on an area of 1.13 ha (0.25 %) the humus supply is very good.

Nitrogen insurance expressed by the nitrogen index (NI) calculated according to the humus content and the degree of base saturation (V%) is poor, the weighted average of NI being 1.49%. Therefore, on an area of 66.26 ha (14.59 %) the nitrogen supply is very poor, on an area of 361.03 ha (79.51 %) the nitrogen supply is poor, on an area of 25.63 ha (5.64 %) the nitrogen supply is average, and on an area of 1.13 ha (0.25 %) the nitrogen supply is good.

CONCLUSIONS

The pedological and agrochemical study carried out on grasslands in the Caransebeș area highlighted important soil characteristics, which directly influence their productivity and agricultural potential. The pedological analysis revealed a diversity of soil types, characterized by physical and morphological properties specific to the contact area between hill and meadow, with a variable texture and a different degree of pedogenetic evolution.

From an agrochemical point of view, the analyzed soils have weakly acidic to neutral reactions, favorable for the development of meadow vegetation, but the content of humus and essential nutrients (nitrogen, phosphorus and potassium) is, in many cases, low or moderate. This indicates an average level of natural fertility and the need to apply improvement measures to support plant mass production.

It was also found that insufficient phosphorus and nitrogen supply is a limiting factor for grassland productivity, while potassium is generally found at satisfactory levels. Soil structure and organic matter content influence water retention capacity, which is particularly important in the context of climatic variability in the area.

In conclusion, the grasslands in the Caransebeș area have an average productive potential, which can be exploited through adequate soil management. It is recommended to apply corrective agrochemical measures, such as rational fertilization, amending acidic soils and maintaining an optimal organic matter content, in order to increase soil fertility and the sustainability of the use of these grasslands in the long term.

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