

INVENTORY OF SOIL RESOURCES AND IDENTIFICATION OF THE LIMITING FACTORS OF LAND USE FOR AGRICULTURAL PRODUCTION IN THE CEPTURA AREA, PRAHOVA COUNTY

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Abstract

The studied territory is located in the east of Prahova County, at a distance of about 33 km from the municipality of Ploiești, with an area of 4700 ha. The study was carried out with the aim of identifying the zonal soil types, their fertility and the description of the limiting or restrictive factors of the use of these lands for agricultural crops. Both main soil profiles and secondary profiles were carried out to reproduce the situation as faithfully as possible soils in the studied area. The identified soil types are represented by Fluvisols, Phaeozems, Gleysols and Technosols. Knowing the nature and intensity of the limiting factors of agricultural production is necessary to establish the ameliorative requirements of the soils, specifying the ameliorative measure and the surface (ha) on which it is applied to reduce or eliminate the negative effects, some measures being conditioned by the initial application of other measures

Key words: evolution, assessment, soil, fertility, limiting factors.

INTRODUCTION

Romania has 14,856.80 ha of agricultural land, which represents 62.3% of the total area, 0.65 ha per capita (Eurostat, 2023).

On approximately 12.5 million ha, soil fertility is negatively affected by erosion, acidity, low humus content, extreme texture (sand, clay), excessive humidity, etc. These natural and anthropogenic factors influence agricultural production.

The paper presents some aspects regarding the quality of the land in the commune of Ceptura Prahova county. According to SRTS (2012), four types of soil were identified in the studied area, which differ distinctly in terms of physical and chemical properties, productive capacity, fertilization measures, etc.

The studied territory is located in the east of Prahova County, at a distance of about 33 km from the municipality of Ploiești. It borders the following communal territories: - to the north - the Gornet Cricov and Tătaru Communal Territories, to the east - the Călugăreni, Vadul Săpat and Fântânele Communal Territories, to the south - the Tomșani Communal Territory, to

the west - the Tomșani, Iordăcheanu and Urlați Communal Territories.

Ceptura commune is located in Subcarpathia (Buzăului Subcarpathia), on the border with the Ialomița Plain (Istrița Glacier).

Climatically, the studied territory is divided into two areas delimited by the landforms. The hilly area belongs to the temperate-moderate type, the subtype of the low hills. Due to the position on the outside of the subcarpathian arc, the low altitudes and the proximity to the eastern half of the Romanian Plain, the climatic characteristics specific to the glacia are those of the lowland climate.

The thermal regime registers an annual average of 10.5°C (glacia area) and 9.9°C (hilly area). Average monthly temperatures gradually reach positive values starting from March (-3°C in January, -1°C in February, +5°C in March). A gradual increase of about 4°C follows each month, reaching an average of 20°C in June (ANMR, 2022).

The average annual precipitation reaches approx. 575 mm/year (glacia area) and 650 mm/year (hilly area), highlighting the drier character of the Subcarpathians.

MATERIALS AND METHODS

Soil is a component of the natural environment that forms and evolves over time at the surface of the lithosphere due to the interaction of physical-geographical factors and human intervention (Ionita et al., 2013).

The influence of relief on pedogenesis is generally manifested by altitude and, on small surfaces, by slope. In the presented case, the relief has a small direct influence due to the morphological characteristics of the terrain: low altitudes and slopes, lack of exposure (Enescu et al., 2018).

The status of a local subsidence (sedimentation) area led to very large thicknesses of rock deposits (clays, loams), thus preparing the ground for the appearance of deeper soils (chernozems, phaeozems) with well-defined horizons (Bv, Bt, Am). They cover the northeastern area of the territory, on the left side of the Cricovului Sarat river and locally other areas spread over the entire area.

Climate is an important factor in the formation and evolution of soils. Under its action, the natural transformation of rocks and minerals occurs, also contributing to the development of vegetation and fauna that will make up the organic part of the soil after the biological cycle is closed (Chiuciu et al., 2017).

Biological activity on the surface and in the soil is the main supplier and processor of organic matter in the pedogenesis process. For cultivated soils, this is less important, the nutrients being made available to the plants following organic and mineral fertilization.

The influence of groundwater is characterized by the development of pedogenetic processes such as glaciation, salinization or alkalization, which generated diagnostic horizons for gleysols or for the gley, saline and alkaline

subtypes. The depth at which these processes occur means that their influence damages the vegetation. The areas covered by these soils are spread over the entire studied territory.

The ordering of soil units was done in accordance with SRTS 2012, identifying a number of 42 soil units (U.S.), respectively 43 elementary land units (U.T.) homogenous in terms of all specific characteristics called ecologically homogeneous territories (T.E.O.).

TERRITORIAL LAND UNIT (U.S.) No. 1. FLUVISOLS entic calcareous gley saline, very strongly salinized weakly proxicalcalcareous glaciated, NLq1/NLq1 on coarse fluvial deposits with skeleton, with soil buried at a shallow depth.

Location: Prahova County, Ceptura Communal Territory

Distribution: in the southwest of the commune, along the river Prahova

Aspect of the land surface: low alluvial plateau - minor bed, 07% slope, very frequent flooding

Natural conditions in which it occurs: meadow, groundwater Q3 0.76-1.40 m, reed cover

CHARACTERISTICS OF THE SOIL

Horizon Atsc 0-03 cm, yellow-rust color 7.5YR 6/8, structured, loamy sand texture, strong effervescence, low porosity, moderately compact, livid, skeleton 6-25%;

Horizon Ck1Goxsc 03-52 cm, yellow-rust color 7.5YR 6/8, monogranular structure, loamy sand texture, strong effervescence, low porosity, moderately compact, livid, skeleton 6-25%;

Horizon CkGrsc 52-80 cm, dark bruised color 5R 3/1, monogranular structure, loamy sand texture, strong effervescence, low porosity, moderately compact, livid, skeleton 6-25%;

Horizon Ck2Goxsc from 80 cm, rust-yellow color 7.5YR 6/8, monogranular structure, loamy sand texture, strong effervescence, low porosity, moderately compact, livid, skeleton 6-25%.

Table 1. Physical characteristics of the soil

Depth	Soil reaction (pH)	(CaCO ₃)	Humus (H)	Phosphorus (P)	Potassium (K)	Coarse sand (Ng)	Fine sand (Nf)	Loam	Clay (A)	Psychical clay (Af)
cm		%	%	ppm	ppm	%	%	%	%	%
0-20	8.14	7.6	0.66	14.9	80.0	16.2	59.2	15.8	8.8	15.1
30-40	7.96	8.2	0.60	16.8	72.0	10.1	66.3	16.1	7.5	17.3
60-70	7.62	6.5	-	-	-	1.5	69.2	21.3	8.0	22.0

Table 2. Chemical characteristics of the soil

Depth cm	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	Total salts
	mg/100 g soil								
0-20	-	38.1	21.3	120.0	40.0	19.5	2.7	-	231.6
30-40	-	41.2	24.8	144.0	62.5	12.0	2.7	4.6	303.5
60-70	-	42.7	23.0	614.0	250.0	18.0	3.9	1.8	1000.0

TERRITORIAL LAND UNIT (U.S.) No. 2. PHAEZOZEMS calcareous gley saline alluvial, moderately saline glaucous slightly proxicalcareous, AL/AL on medium-fine fluvial deposits.

Location: Prahova County, Ceptura Communal Territory

Distribution: in the center of the studied territory

Aspect of the land surface: high alluvial plateau, slope 01%

Natural conditions in which it occurs: drift plain, groundwater Q4 2.01-3.00 m

CHARACTERISTICS OF THE SOIL

Horizon Apsc 0-21 cm, black color 10YR 1.7/1, disturbed structure, clay texture, moderate effervescence, very low porosity, very compact, dry;

Horizon Amsc 21-33 cm, black color 10YR 1.7/1, granular structure, clay texture, strong effervescence, very low porosity, very compact, dry;

Horizon ACkgsc 33-50 cm, yellowish brown color 10YR 5/8 with oxidation spots 10R 5/8, small angular polyhedral structure, clay texture, strong effervescence, very low porosity, very compact, dry;

Horizon Ckgs 50-100 cm, yellow color 2.5GY 4/1 with oxidation spots 10R 5/8, massive structure, clay texture, strong effervescence, very low porosity, very compact, dry;

Horizon CkGox from 100 cm, yellow color 2.5GY 4/1 with oxidation spots 10R 5/8, massive structure, clay loam texture, strong effervescence, very low porosity, very compact, dry.

Table 3. Physical characteristics of the soil

Depth cm	Soil reaction(pH)	(CaCO ₃)	Humus (H)	Phosphorus (P)	Potassium (K)	Coarse sand (Ng)	Fine sand (Nf)	Loam (P)	Clay (A)	Physical clay (Af)
		%	%	ppm	Ppm	%	%	%	%	%
0-20	7.80	3.6	4.92	64.4	-	0.5	16.7	22.9	60.3	80.1
40-50	7.90	6.8	6.06	12.1	272.0	0.2	20.1	19.1	60.6	76.7
60-70	8.00	7.4	-	-	-	0.5	14.4	25.0	60.1	80.6
100-110	8.10	7.4	-	-	-	0.6	29.9	33.7	35.8	54.6

Table 4. Chemical characteristics of the soil

Depth cm	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	Total salts
	mg/100 g soil								
0-20	-	42.7	26.6	67.2	47.4	4.5	5.9	-	204.3
40-50	-	38.1	24.8	60.7	42.5	4.5	3.5	-	194.2
60-70	-	42.7	18.5	48.0	32.5	32.5	2.3	-	174.2
100-110	-	14.5	17.8	38.4	37.5	37.5	2.3	-	134.1

TERRITORIAL LAND UNIT (U.S.) No. 3. GLEYOSOLS calcareous soft saline alluvial, excessively salinized slightly proxicalcareous glaciated, AL/AL on medium-fine fluvial deposits.

Location: Prahova County, Ceptura Communal Territory

Distribution: in the center of the studied territory and in the south of the village of Cornu de Jos

Aspect of the land surface: high alluvial plateau, slope 01%

Natural conditions in which it occurs: drift plain, groundwater Q3 1.01-2.00 m

CHARACTERISTICS OF THE SOIL

Horizon Apgsc 0-21 cm, very dark brown color 10YR 3/1 with oxidation spots 10R 5/8, disturbed structure, clay texture, strong effervescence, low porosity, moderately compact, jiggly;

Horizon AmGoxsc 21-27 cm, very dark brown color 10YR 3/1 with oxidation spots 10R 5/8 and reduction spots 5BG 5/1, granular structure, clay texture, strong effervescence, low porosity, moderately compact, livid, powdery of CaCO₃;

Horizon ACkGoxsc 27-40 cm, very dark brown color 10YR 3/1 with oxidation spots 10R 5/8 and reduction spots 5BG 5/1, massive structure, clay texture, strong effervescence, low porosity, moderately compact, livid, powdery of CaCO₃;

Horizon Ck1Grsc 40-60 cm, dark bluish gray color 5BG 3/1, massive structure, clay texture, strong effervescence, small porosity, moderately compact, livid, CaCO₃ powder;

Horizon Ck2Grsc 60-90 cm, dark burgundy color 5P 3/1, massive structure, clay texture, moderate effervescence, low porosity, moderately compact, livid;

Horizon CkGr from 90 cm, dark burgundy color 5P 3/1, massive structure, clay loam texture, weak effervescence, low porosity, moderately compact, moist.

Table 5. Physical characteristics of the soil

Depth	Soil reaction (pH)	(CaCO ₃)	Humus (H)	Phosphors (P)	Photassium (K)	Coarse sand (Ng)	Fine sand (Nf)	Loam	Clay (A)	Psyhical clay (Af)
cm		%	%	ppm	ppm	%	%	%	%	%
0-20	7.88	6.5	1.62	36.4	244.0	1.8	23.5	23.2	51.5	74.2
30-40	7.88	7.6	4.32	27.3	252.0	2.5	8.0	31.3	58.2	88.7
45-55	7.95	9.5	2.16	16.8	196.0	0.2	34.2	42.3	47.8	78.9
70-80	8.10	2.3	-	-	-	4.6	29.8	20.0	45.6	61.1
100-110	7.96	1.7	-	-	-	0.7	31.5	22.8	45.0	57.7

Table 6. Chemical characteristics of the soil

Depth	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	Total salts
cm	mg/100 g soil								
0-20	-	54.9	21.3	144.0	65.0	13.4	5.8	-	300.4
30-40	-	50.0	17.8	86.4	46.0	7.5	2.5	-	212.7
45-55	-	54.9	17.8	41.8	98.9	2.2	1.2	-	210.2
70-80	-	58.0	26.6	19.2	36.0	1.5	1.2	3.9	154.9
100-110	-	54.9	26.6	31.2	27.6	7.6	1.0	6.0	146.4

TERRITORIAL LAND UNIT (U.S.) No. 4. TECHNOSOLS spoliic saline calcareous lithic, weakly salinized proxicalcareous epilithic, LL/LLq3 on anthropogenic deposits (permeable gravels).

Location: Prahova County, Ceptura Communal Territory

Distribution: in the southeast of the studied territory

The aspect of the land surface: high alluvial plateau filling, slope 01%

Natural conditions in which it occurs: drift plain, groundwater Q4 4.01-10.00 m

CHARACTERISTICS OF THE SOIL

Horion A_t 0-03 cm, light yellowish brown color 10YR 6/4, monogranular structure, clay texture, strong effervescence, low porosity, moderately compact, dry;

Horizon ACk 03-20 cm, light yellowish brown color 10YR 6/4, monogranular structure, clay texture, strong effervescence, low porosity, moderately compact, dry;

Horizon CkR 20-40 cm, light yellowish brown color 10YR 6/4, monogranular structure, clay texture, strong effervescence, very high porosity, very compact, dry, skeleton 70%;

Horizon R from 40 cm, permeable gravels.

Table 7. Physical characteristics of the soil

Depth	Soil reaction (pH)	(CaCO ₃)	Humus (H)	Phosphors (P)	Phytassium (K)	Coarse sand (Ng)	Fine sand (Nf)	Loam (P I)	Clay (A)	Psychical clay (Af)
cm		%	%	ppm	ppm	%	%	%	%	%
0-20	8.10	7.0	1.44	29.9	224.0	11.4	37.4	28.6	22.6	40.8

Table 8. Chemical characteristics of the soil

Depth	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	Total salts
cm	mg/100g sol								
0-20	-	54.9	24.8	57.6	48.0	1.4	3.9	7.0	200.0

RESULTS AND DISCUSSIONS

Knowing the nature and intensity of the limiting factors of agricultural production is necessary to establish the ameliorative requirements of the soils, specifying the ameliorative measure and the surface (ha) on which it is applied to reduce or eliminate the negative effects, some measures being conditioned by the initial application of other measures.

The studied territory is conditioned by the manifestation of certain limiting factors that are described for each soil unit/land unit (U.S./U.T.) together with the main ameliorative measures below.

Salting and alkalinizing – process of increasing the content of soluble salts in the soil and/or replacing the bivalent cations in the adsorptive complex of the soil with Na⁺ ions.

The main ameliorative measures:

- improvement of salinity;
- washing the salts;
- fine-tuning with gypsum;
- rice cultivation on salt flats.

Acidity or debaseification – quantity that indicates the acid content of a solution and which is expressed by its concentration in hydrogen ions.

The main ameliorative measures: fining with limestone.

The degree of settlement – ratio between the apparent density of a soil at a given moment and a standard apparent density.

The main ameliorative measures: deep loosening.

Anthropogenic degradation (pollution) – impurity process of air, natural surface or underground waters or soil.

The main ameliorative measures: combating pollution.

Land slope – inclination of a slope, a land surface or the longitudinal profile of a valley.

The main ameliorative measures:

- capital leveling;
- terracing, earth waves.

Excess moisture – water content in the soil that exceeds the needs of the plants, produces a deficit of aeration and/or creates difficulties for circulation on the surface of the soil, thus reducing harvests or preventing the practice of agriculture. It can be surface or phreatic.

The main ameliorative measures:

- surface drying;
- superficial drainage.

Flooding by overflow – the phenomenon of leveling of the soil surface, usually on low meadow or terrace surfaces, with water from a river overflowing its banks as a result of a sudden increase in its flow rate or from other sources.

The main ameliorative measures:

- dams and stream regulation.

Low reserve of nutrients – chemical elements necessary for plant growth and used in food and tissue production.

The main ameliorative measures:

- radical fertilization.

Covering the land with reeds, groves, sycamore trees or poplars - degradations that reduce

agricultural production, especially on land used for pasture and hay.

The main ameliorative measures:

- dedusting;
- destruction of leeches;

- clearing and removing stumps.

The synthetic situation of the main analyzed parameters is presented for the studied area in the tables.

Table 9. Soil reaction (pH)

Soil reaction	Surface	
	ha	%
Moderately acid soils	195.80	2.61
Weakly acid soils	513.99	6.84
Neutral soils	293.71	3.91
Weakly alkaline soils	6510.50	86.64
Total surface	7514.00	100.00

The charted soils record values located in the moderately acid - weakly alkaline range, with soils with a weak alkaline reaction predominating.

The assessment of the state of provision with accessible forms of nitrogen correlates directly with the provision of the soil with humus H%

and with the degree of saturation in bases V% - which is why the nitrogen index (IN) is calculated representing the product $(H\% \times V\%) / 100$.

The charted soils record values located in the weak - well supplied with nitrogen range, predominating the soils with moderate supply.

Table 10. Status of insurance of soils with nitrogen (IN)

Nitrogen insurance status after IN	Surface	
	Ha	%
Poorly secured soils	1252.33	16.67
Medium secured soils	5322.42	70.83
Well secured soils	939.25	12.50
Total surface	7514.00	100.00

Table 11. State of insurance with mobile forms of phosphorus (P mobile)

Soil insurance status with P mobile (ppm)	Surface	
	Ha	%
Very poorly secured soils	24.48	0.33
Soluri slab asigurate	416.08	5.54
Moderately secured soils	1346.16	17.92
Well secured soils	3059.45	40.72
Very well secured soils	2667.84	35.50
Total surface	7514.00	100.00

The charted soils record values located in the very poor range - very well supplied with

phosphorus, predominating the soils with good and very good supply.

Table 12. Insurance state with mobile forms of potassium (mobile K)

Soil insurance status with K mobile (ppm)	Surface	
	Ha	%
Medium secured soils	513.99	6.84
Well secured soils	1737.77	23.13
Very well secured soils	5262.25	70.03
Total surface	7514.00	100.00

The charted soils record values located in the middle range - very well supplied with

potassium, predominating the soils with very good supply.

The quality class for the common agricultural total is the III (medium quality land) with credit score 41, and the classification of agricultural land by use in quality classes was made according to the following scheme:

- ARABIL

→ class II - 848.00 ha (12.46 %) credit score 65.

→ class III - 2798.00 ha (41.10 %), credit score 49

→ class IV - 2684.00 ha (39.43 %), credit score 31

→ class V - 477.00 ha (7.01 %) credit score 16.

CONCLUSIONS

The charted soils record values located in the moderately acid - weakly alkaline range, with soils with a weak alkaline reaction predominating.

The supply of soil nutrients is predominantly moderate for nitrogen, good and very good for phosphorus and very good for potassium.

The acid reaction of the soils is corrected by calcareous amendment, and the deficiency of nutrients by organic and mineral fertilization.

The choice of improvement perimeters (areas) will be made based on priorities, but also taking

into account the possibilities of executing the works necessary for the improvement, including those of transport and access to the perimeters. The surfaces will be finalized following the performance of special agrochemical and/or pedological studies and economic efficiency calculations.

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