CONSIDERATIONS REGARDING THE TEXTURAL HETEROGENEITY OF SOILS ON THE STRAIGHT SLOPE OF THE VALEA URSULUI STREAM RECLAIMED BY ANTI-EROSION WORKS, IAȘI COUNTY

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Abstract

The present study investigates the textural heterogeneity of soils on the rehabilitated agricultural terraces of the Valea Ursului stream slope, part of the Ezareni farm in Miroslava commune, Iași County, Romania.

The study area, located within the geomorphological framework of the Iași Ridge, is characterized by a complex slope system influenced by the contact between the Central Moldavian Plateau and the Jijia-Bahlui Plain. Dominant soil types include cambic chernozem, calcaric chernozem, colluvial chernozem, clinogleic chernozem, and eroded or anthropogenically altered soils (eroded and exposed anthrosols).

Soil samples were collected from five representative profiles, each analyzed up to a depth of 100–150 cm, encompassing all pedogenetic horizons. Laboratory analyses revealed that slope terracing and anti-erosion interventions altered soil texture, particularly in the arable layer and underlying horizons. These textural changes have critical implications for soil physical properties, including tillage resistance, porosity, water and air permeability, and water retention capacity.

The findings highlight the importance of monitoring textural dynamics in reclaimed agricultural terraces to ensure sustainable land management. This study provides valuable insights for optimizing soil conservation strategies in similar erosion-prone landscapes, contributing to the long-term stability and productivity of agro-ecosystems in northeastern Romania.

Key words: soil texture dynamics, chernozem degradation, slope complex, terracing effects

The mineral constituents of the solid part of the soil represented by sand, silt, and clay form the soil texture or granulometry (Onwuegbunam D. O. et al., 2025).

The proportion of sand, silt, and clay determines the type of soil texture. Determination of particle size fractions according to the Atterberg scale (1912): - sand: 2 - 0.02 mm Ø; - silt: 0.02 - 0.002 mm Ø; - clay: < 0,002 mm Ø. In contemporary pedology, the soil is considered a natural or diverse body modified by man, formed on the land surface, it is a unique natural resource, used as a means of production, a good that was not created or produced by man and is limited in extent, unmultiplicable and irreplaceable (Jităreanu G. et al., 2020). The main criterion by which the limits of separation between particle size fractions are established is to include in the same category particles having practically the same properties.

An elementary particle is defined as a solid, silicate mineral particle that cannot be divided into smaller particles by simple physical or chemical treatments (Canarache A., 1990; Filipov F., 2005).

Texture is the main physical property of soil, with a particularly important role in determining most of the other physical properties as well as many chemical properties. Texture is a practically unchangeable soil characteristic, therefore agricultural and amelioration technologies must take into account this particularity of each soil type.

Soils are also considered three-dimensional natural bodies of relatively loose material, located on the surface of the Earth's crust and composed of mineral, organic components, and living organisms, interacting, with physical, chemical biological, and morphologically different from those of the parent materials from which it was formed and evolved over time through specific pedogenetic and pedogeologic (reliefogenetic) processes under the action of climate and living organisms in different relief conditions, having their own organization and being capable of continuous exchange of substances and energy with the environment, of self-development and of providing the necessary conditions for the growth of terrestrial plants, their main property being

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fertility (Florea N. , 1994; 2004; Amponsah J. et al., 2025).

On agricultural soils, compaction is a process of soil degradation and in the field of construction is a necessary work carried out by specific technological procedures. Compaction can have natural or anthropogenic causes (Canarache A., 1990).

The indicators of the state of soil compaction are represented by the morphological type of structure, the uniformity of root distribution, apparent density and total porosity in correlation with soil texture, aeration porosity, degree of compaction, packing density, etc..

In order to assess the state of soil compaction on the slope developed by soil erosion control works, we analyzed the state of compaction of the soil evolved under the influence of forest vegetation and soil on the arable land on the Ezăreni plateau. The comparative study of the soil compaction of soils on the landscaped slope and those representative of the Ezăreni plateau allowed to highlight the effect of the slope shaping works on soil compaction on the agro-terraces and the grassed strips.

MATERIAL AND METHOD

Location of research

Geomorphologically, the Ezăreni farm lies within the Iași Coast (Strunga-Voinești-Mogoșești-Ciurea-Tomești), bordered by the Central Moldovan Plateau to the west and south, and the Moldavian Plain/Jijia-Bahlui Plain to the east.

The farm's land occupies the interfluve defined by the Valea Ursului (Ezăreni) stream to the north, the Cornești stream to the west, the Boaghia stream to the south, and the Podiș plateau to the west. Elevation ranges from 58 m at the Valea Ursului-Cornești confluence to 132 m on La Podiș hill.

Dominant soils include Cambic chernozemic, calcareous chernozemic, clogged Cambic chernozemic, clinogleic chernozemic, and, on slopes, weakly to moderately eroded Cambic chernozemic or decopatic chernozemic, and eroded/decopatic anthrosols.

Soil profiles (Fig. 1) were located on the right slope of the Valea Ursului stream, a left tributary of the Ezăreni stream, which feeds into the Nicolina stream. The elevation ranges from 67.1 m at the slope's base in the northeast to 97.1 m at its crest in the center, a relief amplitude of 30 m.

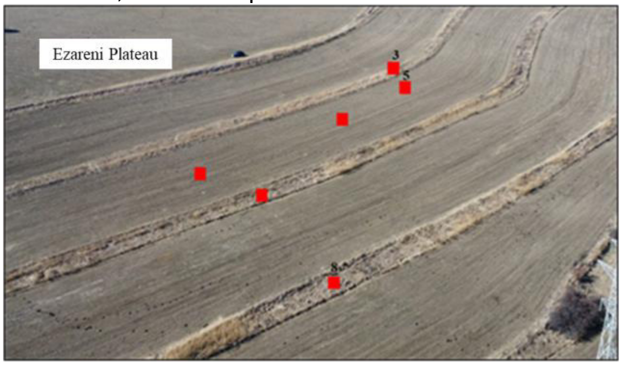

Figure 1. Location of soil profiles

Particle size analysis methodology

Particle size analysis involved pretreatment based on sample composition:

- Carbonates > 2%, organic matter < 5%: 1N hydrochloric acid treatment, followed by dispersion with 4% tetrasodium pyrophosphate.
- Carbonates < 2%, organic matter > 5%: Organic matter oxidation with 30% hydrogen peroxide, followed by dispersion with 4% tetrasodium pyrophosphate.
- Carbonates < 2%, organic matter < 5%: Dispersion with 4% tetrasodium pyrophosphate.
- Carbonates > 2%, organic matter > 5%: 1N hydrochloric acid treatment (carbonate removal), organic matter oxidation with 30% hydrogen peroxide, and dispersion with 4% tetrasodium pyrophosphate.

Particle size fractions were determined using:

-Pipette method: fractions ≤ 0.02 mm;

- Wet and dry sieving: fractions and sub-fractions between 2-0.02 mm.

Results are expressed as percentages of pretreated material, totaling 100%. Textural classification followed both the international system (ICPA Methodology, 1987) and the American system.

RESULTS AND DISCUSSIONS

Profiles P3, P5, and P8 represent soils uncovered by agropropedimentary improvement works, including eroded soils (P3, P8) and eroded-covered soils (P5) found on weathered and arable strips (Fig. 2).

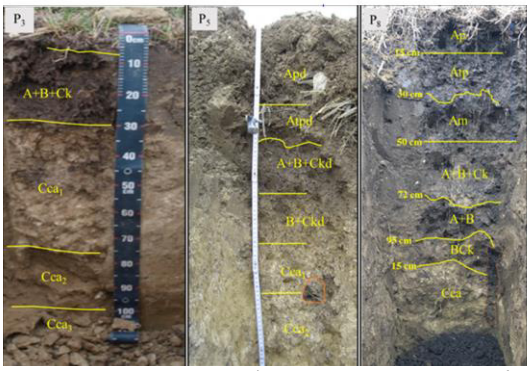

Figure 2. Anthropogenic macromorphologically modified soils resulting in Calcareous Decopperic Soil, (P3), Molic Erodic Soil (P5) and Cernocambic Aric Soil (P8)

The calcareous decopic anthrosol, P3, shows a clay maximum in the Cca1 horizon located at a depth of 30-75 cm, followed by a decrease in depth from 41.5% to 27.1%, going from medium clayey loam to medium loam texture (fig. 3). At depths of more than 100 cm, the lithological fine sand content increases.

In the anthrosol, the presence of the moderately and strongly subsided layer at shallow depth is remarkable.

The susceptibility to compaction of the anthrosols is emphasized by the shallow presence of the moderately and strongly compacted layer (Atp) formed shortly after the slope redevelopment.

The compaction of the arable substrate was favored by the low permeability for water and air, as well as by the temporary manifestation of stagnant excess moisture. The lithological discontinuities within the eroded anthrosols amplify the temporary occurrence of excess moisture and shorten the duration of the optimum period for agricultural work.

The infiltration of water is also slowed down due to the reduced drainage porosity of the shallow carbonate-accumulating C horizon, as a result of precipitation and deposition of calcium carbonate, which clogs some of the existing pores.

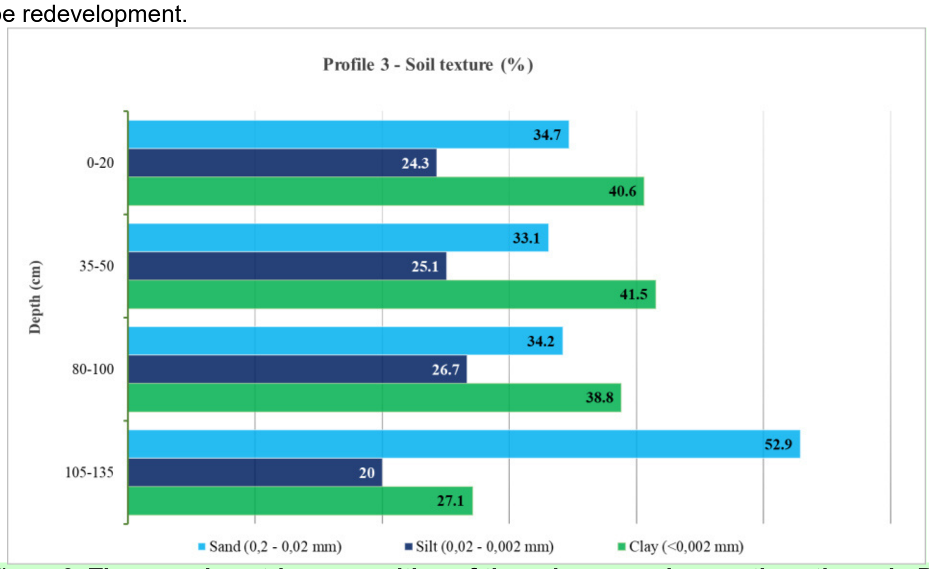

Figure 3. **The granulometric composition of the calcareous decopertic anthrosol - P3**

The Molic eroded erodic anthrosol (P_5), located where leveling and stripping occurred during terracing, exhibits the highest clay content (>45%) in its upper soil horizon among the studied profiles, classifying it as a clay loam. This clay dominance, illustrated in Fig. 4, makes P_5 highly resistant to plowing.

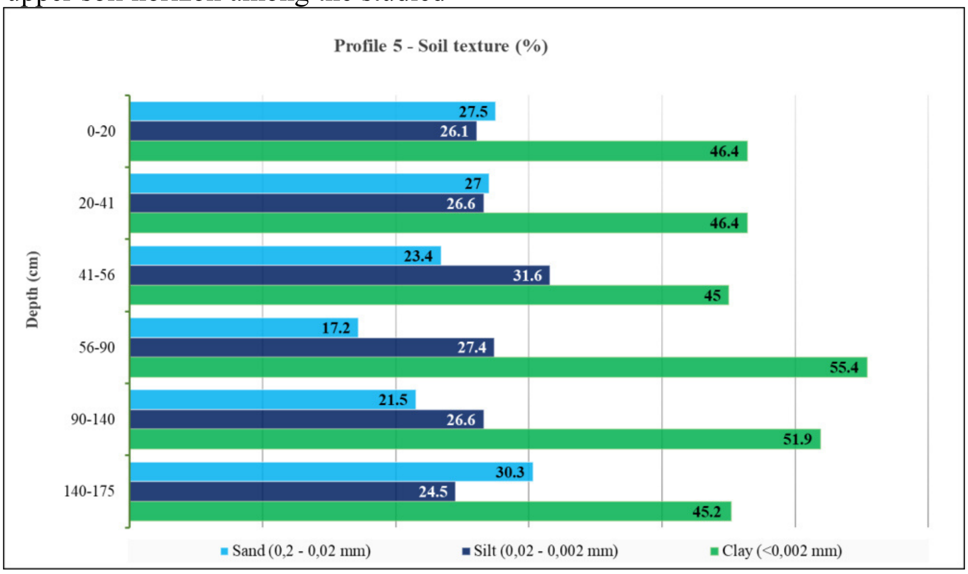

Figure 4. Particle size fractions of the mollic erodic anthrosol – P5

The cernocambic clay loam (P8) exhibits a peak clay content of 36.9% in the Atp horizon (15-25 cm depth), decreasing to a medium loam texture by the BCk transition horizon (80-100 cm). Below 120 cm, fine sand content reaches a maximum of 54.2% while clay content drops to a minimum of 20.6% (Figure 5).

Figure 5. The content of fine sand, silt and clay P8

CONCLUSIONS

As a result of very intensive local improvement activities, highly anthropogenically modified soils have resulted, represented by erodic-decopertic, calcareous, erodic-molic and aric, cernocambic soils.

The erodic anthrosols occur only locally as a result of stripping and levelling of small mounds of old stabilized landslides.

The values of the ratio of non-leachable particle size fractions silt/sand allowed the lithologic discontinuities of the deluvial deposits from which the soils on the landscaped slope were formed to be highlighted.

The susceptibility to compaction of the eroded soils is evidenced by the presence at shallow depth of the moderately and strongly compacted layer (Atp) formed shortly after the slope redevelopment.

The presence of the hardpan layer, observed in the field at the depth of 25-35 cm, is confirmed by the low values of total, useful and draining porosities.

The lithologic discontinuities within the eroded anthrosols amplify the temporary manifestation of excess moisture and shorten the duration of the optimal period for agricultural tillage.

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