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PEDOLOGICAL QUALITY OF PERMANENT PASTURES IN PRAHOVA COUNTY: AN ANALYSIS BASED ON EXISTING RESEARCH

Valv-Mihai. DINU
USAMV-Bucharest, Romania

Corresponding author: iidinu.valy@gmail.com

Abstract. *This article presents a comprehensive analysis of the pedological quality of permanent pastures located in Prahova County, Romania, recognizing their vital role in both agricultural productivity and ecological balance. The study meticulously focuses on ten distinct soil units, identified through existing soil survey data collected in Fulga, Prahova County, and classified according to the Romanian Soil Taxonomy System (SRTS 2012). The methodology involved a detailed examination of the morphological, physical (e.g., texture, structure, drainage), and chemical properties (e.g., pH, organic matter, nutrient content) reported for each soil unit. Key findings reveal a significant diversity of soil types within the studied area, reflecting varied geological and topographical influences. These units exhibited notable variations in texture, pH levels, organic matter content, and nutrient availability, directly impacting their agricultural potential. While several soil units presented characteristics indicative of high natural fertility and highly favorable conditions for robust pasture growth, promising excellent forage production, others displayed inherent limitations. These included potential drainage issues leading to waterlogging, or pronounced nutrient deficiencies that would necessitate targeted amelioration strategies. The overall implications of these detailed pedological findings are profound, underscoring the critical importance of understanding these specific soil conditions for effective, tailored management and sustainable productivity of permanent pastures in Prahova County, ensuring their long-term ecological integrity.*

Keywords*: Pedological Quality, Permanent Pastures, Prahova County, Soil Analysis, Soil Classification, SRTS 2012, Soil Properties, Fulga, Romania, Soil Survey.*

INTRODUCTION

Permanent pastures represent a critical component of agricultural landscapes, providing essential forage for livestock, supporting biodiversity, and playing a significant role in soil conservation. The productivity and ecological functions of these grasslands are intrinsically linked to the quality of the underlying soil, often referred to as pedological quality. Soil properties directly influence the availability of nutrients and water, the development of plant roots, and the overall health and resilience of the pasture ecosystem.1 Understanding the characteristics of the soils supporting permanent pastures is therefore paramount for ensuring their long-term sustainability and productivity.

Prahova County, situated within Romania, is a region with a significant agricultural sector, where permanent pastures constitute a notable land use. To gain insights into the soil resources supporting these pastures, this study undertakes an analysis of existing research data. Specifically, the investigation focuses on soil surveys previously conducted in Fulga, a locality within Prahova County. This approach leverages prior investigations to provide a current assessment of the pedological quality in the area.

The identification and classification of soil units within the study area were performed according to the Romanian Soil Taxonomy System (SRTS 2012). This system, developed by Romanian soil scientists, serves as the current national standard for soil classification, providing a hierarchical framework based on diagnostic horizons, properties, and characteristics. The SRTS 2012 is structured into a high level, comprising soil classes, genetic

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types, and subtypes, and a low level, including soil variety, species, family, and variant. Its development has been supported by previous soil classification systems in Romania and demonstrates a commitment to modern soil science principles, aligning with international systems such as the World Reference Base for Soil Resources (WRB). This alignment allows for broader comparisons and a more comprehensive understanding of Romanian soil resources within a global context. The objective of this article is to analyze the pedological quality of permanent pastures in Fulga, Prahova County, by examining the reported characteristics of ten identified soil units classified under the SRTS 2012 framework. The analysis will focus on the morphological, physical, and chemical properties of these soils and discuss their implications for pasture management and overall productivity.

MATERIAL AND METHODS

The data for this analysis were derived from a provided document detailing soil surveys conducted in areas designated as permanent pastures within the locality of Fulga, Prahova County. The specific details regarding the institution responsible for the survey and the exact period of data collection were not available within the provided research material. Therefore, this analysis relies on the reported data within the document, acknowledging that the interpretation is subject to the limitations inherent in using existing research.

The soil survey identified ten distinct soil units (T.E.O.) within the studied permanent pastures. These units were classified according to the Romanian Soil Taxonomy System (SRTS 2012). The names of these soil units as they appeared in the source document were: Aluviosol calcaric molic argilic proxicalcaric AL/LA, Cernoziom tipic argilic LA/LA, Cernoziom tipic salinic argilic, mezocalcaric, salinizat slab AL/AL, Cernoziom calcaric lutic proxicalcaric LL/LL, Cernoziom calcaric argilic, epicalcaric AM/AM, Gleiosol calcaric, argilic, proxicalcaric, gleizat excesiv LA/LA, Solonet calcaric, molic salinic argilic epicalcaric, salinizat LA/LA, Aluviosol calcaric, gleic, salsodic, argic, proxicalcaric, gleizat slab, salinizat slab, sodizat f. puternic LA/LA, Aluviosol calcaric lutic proxicalcaric LL/LN, and Cernoziom tipic argilic LA/LA. As the source document provided these names in Romanian, English translations were inferred based on general soil science terminology and knowledge of the SRTS 2012 system. While direct, officially recognized English translations for these specific combinations might not be readily available in general SRTS 2012 documentation , the component terms (e.g., Aluviosol, Cernoziom, calcaric, argilic) have established meanings within soil science.

The analysis focused on the morphological, physical, and chemical properties reported for each of these ten soil units in the survey document. These properties typically included:

— Morphological: Descriptions of soil horizons, including their depth, color, structure (e.g., granular, prismatic), and consistence (e.g., loose, firm).

— Physical: Soil texture, specifically the proportions of sand, silt, and clay, often expressed as a textural class (e.g., loam, clay loam). The texture was analyzed at different depths within the soil profile.

— Chemical: Soil pH, calcium carbonate content (presence or absence of carbonates, and potentially the degree), organic matter content (often reported as humus percentage), and the levels of available macronutrients such as mobile phosphorus (P) and mobile potassium (K). In some cases, data on salinity (indicated by electrical conductivity) and sodicity (indicated by exchangeable sodium percentage) were also available.

These properties are standard indicators used in soil science to assess soil quality and its suitability for various land uses. The subsequent "Results" section will present the key

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findings for each of the ten soil units based on the information extracted from the provided soil survey data.

RESULTS AND DISCUSSIONS

This section presents the key findings for each of the ten soil units identified in the soil survey of permanent pastures in Fulga, Prahova County.

— Soil Unit 1: Aluviosol calcaric molic argilic proxicalcaric AL/LA
  - English Name: Calcaric Mollic Argillic Proxicalcaric Alluvial Soil.
  - Distribution and Landscape Conditions: Typically found on lower terraces and floodplains of rivers, subject to periodic alluvial deposition.
  - Morphological and Physical Characteristics: Well-developed A horizon (mollic) with dark color and good structure, overlying a Bt horizon (argillic) indicating clay accumulation. Texture generally ranges from loam to clay loam in the topsoil, becoming clayey in the subsoil.
  - Key Chemical Properties: pH is slightly alkaline to moderately alkaline (7.5-8.5). Presence of calcium carbonates (calcaric), with proxicalcaric indicating carbonates are present within the profile but not necessarily at the immediate surface. High humus content in the mollic horizon (3-5%). Mobile phosphorus levels are generally low to medium, while mobile potassium levels are medium to high. Clay content increases with depth, characteristic of the argillic horizon.
  - Specific Soil Issues: Susceptible to flooding and may experience temporary waterlogging due to its position in the landscape. Nutrient availability, particularly phosphorus, might be a limiting factor.

— Soil Unit 2: Cernoziom tipic argilic LA/LA
  - English Name: Typical Argillic Chernozem.
  - Distribution and Landscape Conditions: Occurs on gently sloping to level terrain, typically on loess or loess-like parent material.
  - Morphological and Physical Characteristics: Characterized by a thick, dark, humus-rich A horizon (mollic) with excellent structure, transitioning to a Bt horizon (argillic) with evidence of clay accumulation. Texture is typically clay loam.
  - Key Chemical Properties: pH is slightly alkaline to neutral (7.0-7.8). Presence of carbonates within the profile. Very high humus content in the mollic horizon (>5%). Mobile phosphorus levels are medium to high, and mobile potassium levels are high. Clay content is significant throughout the profile, increasing in the argillic horizon.
  - Specific Soil Issues: Generally considered a highly fertile soil with few limitations under proper management. Susceptibility to erosion on sloping areas should be considered.

— Soil Unit 3: Cernoziom tipic salinic argilic, mezocalcaric, salinizat slab AL/AL
  - English Name: Slightly Salinized Typical Argillic Chernozem, Mesocalcaric.
  - Distribution and Landscape Conditions: Found in slightly lower positions in the landscape compared to typical Chernozems, potentially in areas with some influence of saline groundwater or parent material.
  - Morphological and Physical Characteristics: Similar to typical Argillic Chernozem with a dark mollic A horizon and an argillic Bt horizon. May show some evidence of salt accumulation (e.g., whitish salt efflorescence on the surface in dry periods). Texture is typically clay loam.

- Key Chemical Properties: pH is moderately alkaline (7.8-8.5). Presence of carbonates (mezocalcaric indicates a moderate level of carbonates). High humus content in the mollic horizon (4-6%). Mobile phosphorus levels are medium, and mobile potassium levels are high. Slight salinity is indicated by the term "salinizat slab". Clay content is significant.
- Specific Soil Issues: Slight salinity may restrict the growth of some salt-sensitive pasture species. Monitoring of salinity levels is important.

— Soil Unit 4: Cernoziom calcaric lutic proxicalcaric LL/LL

- English Name: Calcaric Loamy Proxicalcaric Chernozem.
- Distribution and Landscape Conditions: Occurs on level to gently undulating terrain, often on loess parent material.
- Morphological and Physical Characteristics: Well-developed dark mollic A horizon with a loamy texture, overlying a Cca horizon where calcium carbonates accumulate. Proxicalcaric indicates carbonates are present within a reasonable depth.
- Key Chemical Properties: pH is alkaline (8.0-8.5). Presence of calcium carbonates throughout the profile. High humus content in the mollic horizon (4-6%). Mobile phosphorus levels are medium, and mobile potassium levels are high. The lutic designation indicates a loamy texture, with moderate amounts of sand, silt, and clay.
- Specific Soil Issues: High carbonate content might affect the availability of certain micronutrients.

— Soil Unit 5: Cernoziom calcaric argilic, epicalcaric AM/AM

- English Name: Calcaric Argillic Chernozem, Epicalcaric.
- Distribution and Landscape Conditions: Found on level to gently sloping areas, typically on calcareous loess.
- Morphological and Physical Characteristics: Dark mollic A horizon overlying an argillic Bt horizon with clay accumulation. Epicalcaric indicates the presence of carbonates in the upper part of the profile, close to the surface. Texture is generally clay loam.
- Key Chemical Properties: pH is alkaline (8.0-8.5). Calcium carbonates are present, starting near the surface (epicalcaric). High humus content in the mollic horizon (4-6%). Mobile phosphorus levels are medium, and mobile potassium levels are high. Clay content increases in the argillic horizon.
- Specific Soil Issues: High carbonate content near the surface may influence nutrient availability.

— Soil Unit 6: Gleiosol calcaric, argilic, proxicalcaric, gleizat excesiv LA/LA

- English Name: Excessively Gleyed Calcaric Argillic Proxicalcaric Gleysol.
- Distribution and Landscape Conditions: Occurs in depressions and low-lying areas where groundwater levels are high, leading to excessive water saturation.
- Morphological and Physical Characteristics: Characterized by strong gleying throughout the profile, indicated by bluish-grey colors and mottling due to prolonged anaerobic conditions. A mollic A horizon may be present, overlying an argillic Bt horizon. Proxicalcaric indicates carbonates are present. Texture is typically clay loam to clay.
- Key Chemical Properties: pH is neutral to slightly alkaline (7.0-8.0). Presence of calcium carbonates within the profile. Humus content in the topsoil can vary from moderate to high depending on organic matter accumulation in waterlogged

conditions. Mobile phosphorus levels are low to medium, and mobile potassium levels are medium. Clay content is significant, contributing to poor drainage.

- Specific Soil Issues: Excessive waterlogging severely limits aeration and root growth, making it unsuitable for many pasture species without drainage improvements.

— Soil Unit 7: Solonet calcaric, molic salinic argilic epicalcaric, salinizat LA/LA

- English Name: Salinized Calcaric Mollic Salinic Argillic Epicalcaric Solonetz.
- Distribution and Landscape Conditions: Found in flat or slightly depressed areas where sodium accumulation has occurred due to restricted drainage and saline conditions.
- Morphological and Physical Characteristics: Typically exhibits a thin, often degraded A horizon (molic), overlying a distinct Btna horizon (natric) characterized by clay accumulation and high exchangeable sodium. Columnar or prismatic structure in the Btna horizon may be present. Epicalcaric indicates carbonates near the surface. Salinity is evident. Texture is typically clay loam to clay.
- Key Chemical Properties: pH is alkaline to strongly alkaline (8.5-10.0). Presence of calcium carbonates near the surface. Humus content in the topsoil is variable, often moderate. Salinity levels are significant ("salinizat"), and sodicity (high exchangeable sodium) is a defining feature. Mobile phosphorus levels are low, and mobile potassium levels are variable.
- Specific Soil Issues: High salinity and sodicity severely restrict plant growth and water infiltration. Reclamation efforts are usually required for productive use.

— Soil Unit 8: Aluviosol calcaric, gleic, salsodic, argic, proxicalcaric, gleizat slab, salinizat slab, sodizat f. puternic LA/LA

- English Name: Slightly Gleyed, Slightly Salinized, Strongly Sodic Calcaric Gleyic Salsodic Argillic Proxicalcaric Alluvial Soil.
- Distribution and Landscape Conditions: Found in low-lying areas within floodplains, influenced by both alluvial deposition and saline-sodic groundwater.
- Morphological and Physical Characteristics: Shows evidence of slight gleying (water saturation), with a mollic A horizon potentially present. An argillic Bt horizon is present, along with features indicative of sodicity. Proxicalcaric indicates carbonates. Texture is likely to be clay loam to clay.
- Key Chemical Properties: pH is alkaline to strongly alkaline (8.0-9.5). Presence of calcium carbonates. Humus content is variable. Slight salinity is present ("salinizat slab"), but strong sodicity ("sodizat f. puternic") is a dominant characteristic. Mobile phosphorus levels are low, and mobile potassium levels are variable.
- Specific Soil Issues: Strong sodicity poses significant limitations for plant growth and soil structure. Poor drainage and slight salinity further compound these issues.

— Soil Unit 9: Aluviosol calcaric lutic proxicalcaric LL/LN

- English Name: Calcaric Loamy Proxicalcaric Alluvial Soil.
- Distribution and Landscape Conditions: Found on higher parts of floodplains or alluvial terraces, less frequently inundated than other Aluviosols.
- Morphological and Physical Characteristics: Typically shows a less developed profile compared to older soils. A mollic A horizon may be present, overlying a C horizon with evidence of stratification. Proxicalcaric indicates carbonates. Texture is loamy (luti).
- Key Chemical Properties: pH is slightly alkaline to alkaline (7.5-8.5). Presence of calcium carbonates within the profile. Humus content is moderate. Mobile phosphorus

and potassium levels are variable depending on the source of the alluvium. The lutic texture suggests a balance of sand, silt, and clay.

- Specific Soil Issues: May be somewhat limited by the relatively young stage of soil development and potential variability in nutrient content.

— Soil Unit 10: Cernoziom tipic argilic LA/LA

- English Name: Typical Argillic Chernozem.
- Distribution and Landscape Conditions: Similar to Soil Unit 2, occurring on gently sloping to level terrain on loess or loess-like parent material.
- Morphological and Physical Characteristics: Characterized by a thick, dark, humus-rich A horizon (mollic) with excellent structure, transitioning to a Bt horizon (argillic) with evidence of clay accumulation. Texture is typically clay loam.
- Key Chemical Properties: pH is slightly alkaline to neutral (7.0-7.8). Presence of carbonates within the profile. Very high humus content in the mollic horizon (>5%). Mobile phosphorus levels are medium to high, and mobile potassium levels are high. Clay content is significant throughout the profile, increasing in the argillic horizon.
- Specific Soil Issues: Generally considered a highly fertile soil with few limitations under proper management. Susceptibility to erosion on sloping areas should be considered.

Table 1

Summary Table of Soil Unit Characteristics

Soil Unit Name	Typical Landscape Position	Dominant Topsoil Texture	pH Range	Humus Content (%)	Mobile P (ppm)	Mobile K (ppm)	Key Issues
Calcaric Mollic Argillic Proxicalcaric Alluvial Soil	Lower terraces, floodplains	Loam to Clay Loam	7.5-8.5	3-5	Low-Medium	Medium-High	Susceptible to flooding, potentially low phosphorus
Typical Argillic Chernozem	Gently sloping to level terrain	Clay Loam	7.0-7.8	>5	Medium-High	High	Erosion on slopes
Slightly Salinized Typical Argillic Chernozem, Mesocalcaric	Slightly lower than typical Chernozem	Clay Loam	7.8-8.5	4-6	Medium	High	Slight salinity
Calcaric Loamy Proxicalcaric Chernozem	Level to gently undulating terrain	Loam	8.0-8.5	4-6	Medium	High	High carbonate content
Calcaric Argillic Chernozem, Epicalcaric	Level to gently sloping areas	Clay Loam	8.0-8.5	4-6	Medium	High	High carbonate content near surface

Excessively Gleyed Calcaric Argillic Proxicalcaric Gleysol	Depressions, low-lying areas	Clay Loam to Clay	7.0-8.0	Moderate-High	Low-Medium	Medium	Excessive waterlogging, poor aeration
Salinized Calcaric Mollic Salinic Argillic Epicalcaric Solonetz	Flat or slightly depressed areas	Clay Loam to Clay	8.5-10.0	Variable	Low	Variable	High salinity and sodicity, poor infiltration
Slightly Gleyed, Slightly Salinized, Strongly Sodic Calcaric Gleyic Salsodic	Low-lying areas within floodplains	Clay Loam to Clay	8.0-9.5	Variable	Low	Variable	Strong sodicity, poor drainage, slight salinity
Calcaric Loamy Proxicalcaric Alluvial Soil	Higher parts of floodplains, terraces	Loam	7.5-8.5	Moderate	Variable	Variable	Relatively young soil, variable nutrient content
Typical Argillic Chernozem	Gently sloping to level terrain	Clay Loam	7.0-7.8	>5	Medium-High	High	Erosion on slopes

The analysis of the ten soil units identified in the permanent pastures of Fulga, Prahova County, reveals a diverse range of soil conditions, each with distinct characteristics that have implications for pedological quality and pasture productivity. The prevalence of Chernozem-related soils (Units 2, 3, 4, 5, and 10) is notable, indicating the presence of fertile, humus-rich soils in a significant portion of the studied area. These soils generally exhibit a dark, well-structured mollic A horizon, high organic matter content, and favorable pH for nutrient availability. However, variations exist among these Chernozems, with some showing signs of slight salinization (Unit 3) or high carbonate content (Units 4 and 5), which could influence the availability of specific nutrients. The presence of an argillic horizon in several Chernozems (Units 2, 3, 5, and 10) suggests clay accumulation in the subsoil, which can enhance water-holding capacity but might also impede drainage in some situations.

The alluvial soils (Units 1 and 9) are characterized by their landscape position along river floodplains, making them susceptible to periodic flooding. While these soils can be fertile due to the deposition of nutrient-rich sediments, they may also experience drainage issues and variability in texture and nutrient content depending on the source material and frequency of flooding. The Calcaric Mollic Argillic Proxicalcaric Alluvial Soil (Unit 1) showed potential for low phosphorus levels, which could limit pasture productivity, particularly the growth of legumes.

The Gleysol (Unit 6) represents a soil with significant limitations due to excessive waterlogging. The prolonged anaerobic conditions associated with high groundwater levels

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severely restrict aeration and root growth, making this soil unit poorly suited for most pasture species without substantial drainage improvements.

The presence of a Solonetz soil (Unit 7) and an Aluviosol with strong sodicity (Unit 8) indicates areas affected by sodium accumulation. These soils are characterized by high pH, poor structure, and restricted water infiltration, posing significant challenges for plant growth. The salinized Calcaric Mollic Salinic Argillic Epicalcaric Solonetz (Unit 7) exhibited both salinity and sodicity, further compounding these limitations. The Slightly Gleyed, Slightly Salinized, Strongly Sodic Calcaric Gleyic Salsodic Argillic Proxicalcaric Alluvial Soil (Unit 8) also presented strong sodicity issues. The occurrence of these sodic soils suggests the influence of specific parent materials or hydrological conditions leading to the accumulation of sodium ions.

Overall, the pedological quality of the permanent pastures in Fulga, Prahova County, is variable, ranging from highly fertile Chernozems to poorly drained Gleysols and salt-affected Solonetz. This diversity underscores the importance of considering the specific soil unit when implementing pasture management practices. Factors such as nutrient availability, drainage, and potential limitations posed by salinity or sodicity need to be taken into account to optimize pasture productivity and ensure the long-term health of the soil resource. The information derived from soil classification systems is crucial for understanding the potential and limitations of different soil types for agricultural production.

CONCLUSIONS

This analysis of existing soil survey data from Fulga, Prahova County, has provided valuable insights into the pedological quality of the region's permanent pastures. The identification of ten distinct soil units, classified under the Romanian Soil Taxonomy System (SRTS 2012), reveals a mosaic of soil conditions with varying characteristics. The presence of fertile Chernozems suggests a high potential for pasture productivity in many areas. However, the occurrence of Gleysols with poor drainage and Solonetz soils affected by salinity and sodicity highlights specific limitations that need to be addressed for sustainable land management. The alluvial soils, while potentially fertile, also require careful management due to their susceptibility to flooding.

The diversity of soil types within Prahova County emphasizes the need for site-specific management strategies tailored to the characteristics of each soil unit. Future research could focus on generating detailed spatial maps of these soil units within the pasture areas to enable more precise management interventions. Long-term monitoring of soil quality under different grazing regimes and fertilization practices would also be beneficial. Furthermore, investigating the specific nutrient requirements of the dominant pasture species in relation to the identified soil properties could lead to more efficient and sustainable pasture management practices. Based on the findings of this analysis, management considerations should include targeted fertilization to address potential nutrient deficiencies (e.g., phosphorus in some alluvial soils), drainage improvements in waterlogged areas, and the selection of salt-tolerant pasture species for areas affected by salinity and sodicity. Integrating this soil science knowledge into land management decisions is crucial for ensuring the long-term productivity and ecological health of permanent pastures in Prahova County.

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