USE OF PEDOLOGICAL DATA TO DETERMINE CROP SUITABILITY

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Abstract

This paper addresses the importance of using pedological data in assessing the suitability of land for major agricultural crops, in the current context of climate change and the need for sustainable natural resource management. The analysis of physical, chemical and biological properties of soil – including texture, pH, humus content and water retention capacity – provides a solid basis for classifying land according to its productive potential. The study combines traditional methods of mapping and pedological analysis with modern GIS technologies and spatial models, allowing the development of precise suitability maps for crops such as wheat, maize, sunflower and potato. The results indicate that chernozem soils represent the most favourable category, followed by luvisols and alluvial soils, which can be improved by soil improvement measures.
Based on the data obtained and recent research in the field, the paper emphasizes the need for the permanent integration of soil information in agricultural planning and the adoption of sustainable agricultural practices to preserve soil fertility. The use of these tools contributes to the optimization of agricultural production, environmental protection and ensuring long-term food security.
The integrated use of soil data and GIS technologies supports agricultural decisions, contributing to the optimization of production and the sustainable management of soil resources.
Key words: soil, culture, favorability

INTRODUCTION

Soil is the fundamental component of the biosphere and is the result of the complex interaction between environmental factors – parent material, climate, vegetation, relief and time – under the influence of human activity. (Popa D., et. al., 2015). It is defined as a natural, dynamic and multiphase system, made up of solid, liquid and gaseous phases, in which interdependent biological, physical and chemical processes take place. (Mazăre Veaceslav, et. al., 2024). Through its properties, soil provides mechanical support, water, air and nutrients to plants, while also fulfilling an essential ecological function in maintaining environmental balance. (Mihuț, Casiana & Niță L. 2018).

The process of soil formation (pedogenesis) leads to its differentiation into horizons, each with distinct characteristics determined by processes such as humification, eluvium, illuvium or mineralization. These horizons define the soil profile, which constitutes the basic unit in pedological studies. (Mihuț, Casiana et.al., 2022).

In assessing the agricultural potential of land, the physical, chemical and biological properties of the soil are of particular importance. (Niță Lucian Dumitru et.al., 2023).

Physical properties (texture, structure, bulk density, porosity, permeability, water retention capacity) determine the aerohydric regime of the soil and influence the accessibility of water for plants. (Stroia Marius, et.al.,2021).

Chemical properties (pH, humus content, cation exchange capacity, content of nutrients – nitrogen, phosphorus, potassium) determine chemical fertility and the ability of the soil to support mineral nutrition processes. (Duma Copcea Anișoara, et.al., 2013).

Biological properties (microbial activity, content of active organic matter) contribute to the stability and regeneration of the soil structure and the availability of nutrients.

All these characteristics define the quality and productive potential of the soil, influencing the suitability for various agricultural crops. (Karel Iaroslav Laţo, et. al., 2022).

The suitability of a land for a certain crop represents the degree of compatibility between the ecological requirements of the plant and the conditions offered by the environment, especially the soil. The main determining factors are:

Climatic factors – temperature, precipitation, solar radiation and wind regime;

Edaphic factors – texture, soil reaction, fertility, aerohydric regime and soil depth;

Topographic factors – altitude, slope, exposure;

Anthropogenic factors – agricultural practices, improvement works and pollution level.

Determining the suitability involves the integrated analysis of these factors, especially the pedological ones, which exert a direct and constant influence on plant development. (Mateoc-Sîrb, N., et. al., 2022, Mateoc-Sîrb, N., et. al., 2024).

Pedological data constitute the scientific basis for land evaluation and substantiating decisions regarding their use. They are obtained through detailed pedological studies, which include the description of soil profiles, the analysis of physicochemical properties, as well as the delimitation and mapping of soil units. (Duma Copcea Anișoara et. al., 2013).

By processing these data, it is possible to determine: the production capacity of the land; the degree of limitation or restrictions imposed by the soil conditions; the potential for improvement through agrotechnical or soil improvement works. (David, S., et.al., 2020).

Currently, the integration of pedological data into geographic information systems (GIS) allows the creation of thematic maps of favorability, which provide a synthetic image of the spatial distribution of optimal conditions for various crops. These modern tools support strategic planning of land use and contribute to the practice of sustainable agriculture, based on knowledge of natural resources. (Duma Copcea Anișoara, et.al., 2024)

MATERIALS AND METHODS

The diversity of soils in the Sânnicolaul Mare area is the result of a complex and continuous interaction between pedogenetic factors (relief, lithology/bedrock, vegetation, climate and hydrology). This dynamic has led to the formation of a very varied soil layer, vital for agriculture. The area includes a wide range of soil types, each with specific properties that dictate how they can be cultivated:

Chernozems - generally represent the most fertile soils in the area. They are characterized by a high humus content and a stable structure, being ideal for a wide range of field crops (wheat, corn).

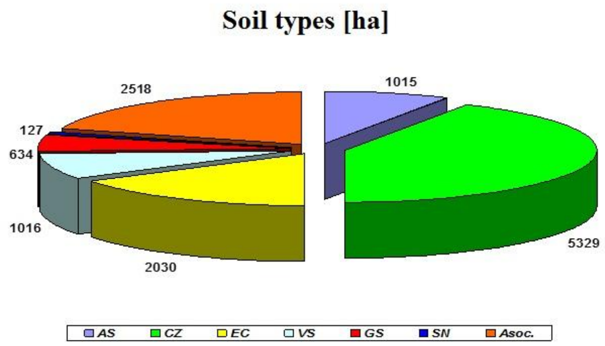
Eutricambosols - are evolved soils, with a well-developed profile and good natural fertility. They are suitable for agriculture, having a favorable chemical balance.

Alluviosols - are frequently found in floodplains and areas adjacent to watercourses. They are young soils, with a variable texture and, often, with a water regime influenced by the groundwater table.

Vertosols - are heavy, clayey soils, which are characterized by pronounced shrinkage and swelling depending on humidity. This gives them a problematic structure for agricultural work and requires careful water management.

Gleiosols - indicate a permanent or periodic excess of moisture in the soil profile, resulting from a high level of groundwater (hydromorphism). They usually require drainage works to be used effectively in agriculture.

Solonets - are saline (salinated/alkalized) soils, with a high content of soluble salts or exchangeable sodium. Their fertility is very limited, requiring special measures of chemical improvement (gypsum) and irrigation.



The studied area within the studied area was 10.44 ha. In 2023-2024 this area was cultivated with wheat. The yield obtained was 5.98 t/ha.

The current crop is rapeseed. A harvest of 4.50t/ha was expected.

3 soil samples were collected for soil analysis.

Based on these analyses, essential for substantiation, the fertilization management plan was designed.

RESULTS AND DISCUSSIONS

Table 1 Chemical analyses

No. samples	pH H_2O	Nitrogen Index%	Humus%	AH	SB	V%	Phosphorus mob.mg/kg	Phosphorus tot.mg/kg	Potassium mob.mg/kg	Potassium tot./kg
				me/100 g /sol						
1	6,06	3,28	3,68	4,55	36,80	89,00	33,62	54,29	180	180
2	6,10	3,20	3,60	4,50	36,00	88,89	33,56	54,67	180	180
3	6,04	3,16	3,56	4,62	36,50	88,76	33,19	54,20	180	180

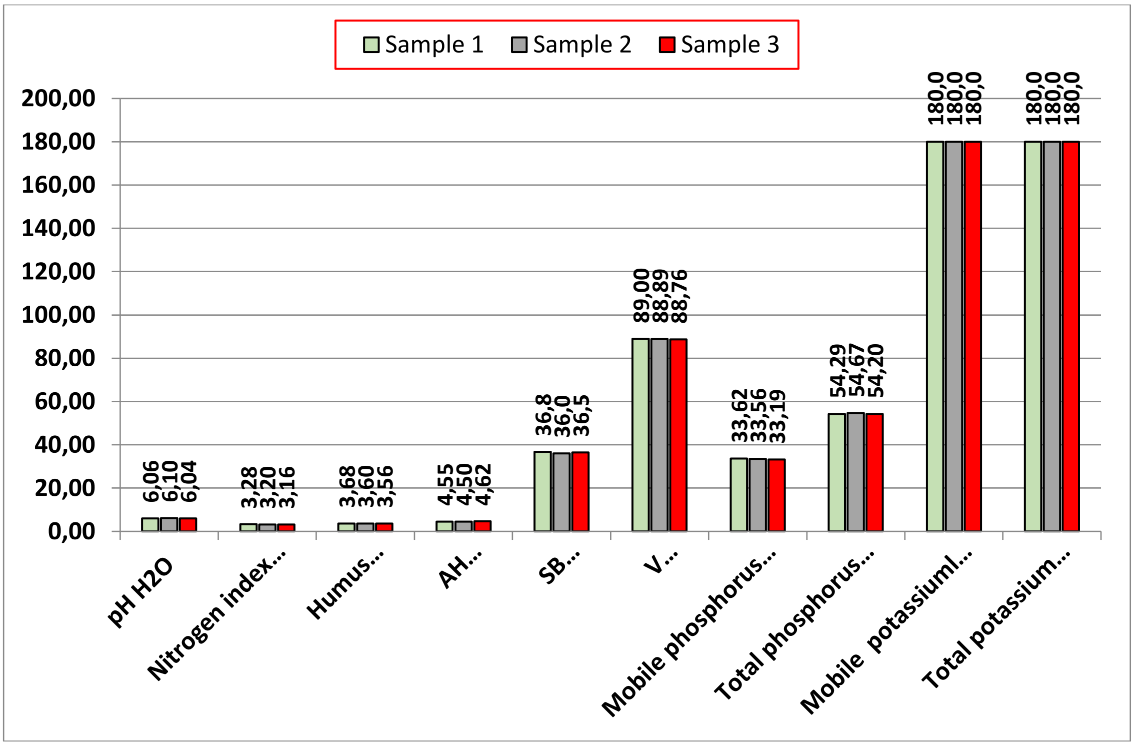


Figure 1 Chemical analyses

Table 2 Microelements (mobile forms)mg/kg

No. samples	Calcium	Magnesium	Aluminum	Manganese	Copper	Iron	Sulfur	Zinc
1	903,77	132,94	1,11	32,34	4,40	4,40	0,84	0,77
2	995,72	392,41	1,66	51,76	6,76	6,76	0,95	1,22
3	712,74	157,96	3,21	50,70	6,55	6,55	1,10	0,96

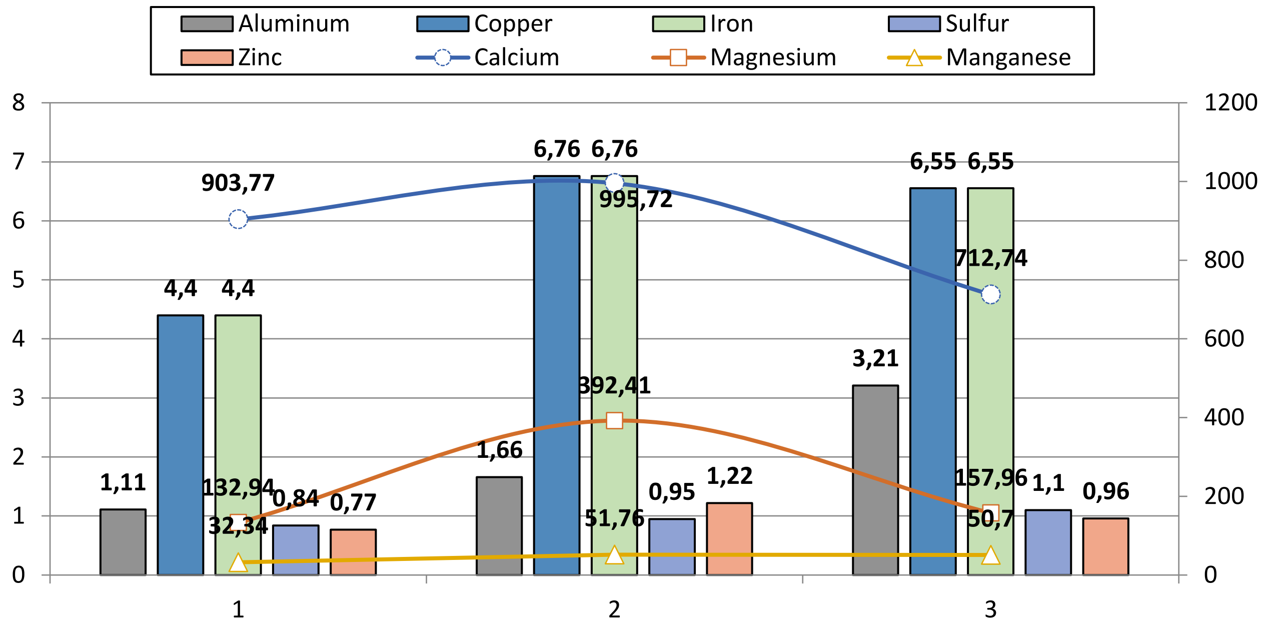


Figure 2 Microelements (mobile forms)mg/kg

Table 3 Nutrient export

Azote			Phosphorus			Potassium		
Seeds	Plant residues	Vegetable waste	Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported
114,00	72.00	186,00	48,00	16,20	64,20	28,20	120,00	148,80

Table 4 Nutrient export

Sulfur			Copper			Manganese		
Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported
10,20	13,80	24,00	0,07	0,03	0,10	0,19	0,53	0,72

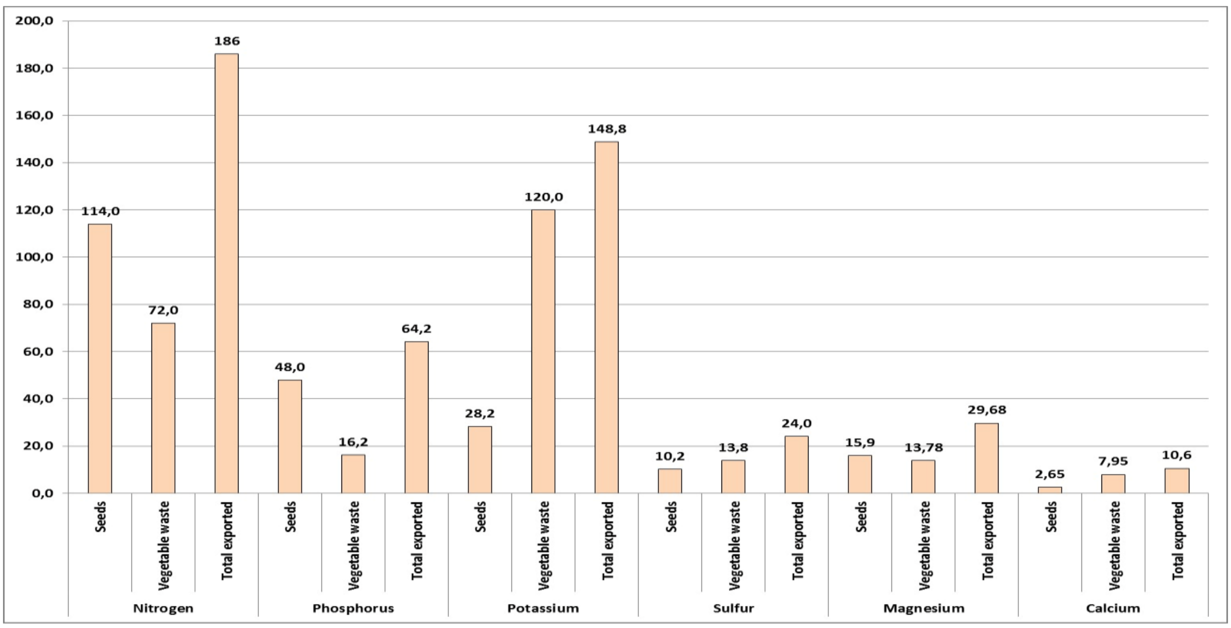


Figure 3 Nutrient export

Table 5 Nutrient export

Magneziu			Calciu			Zinc		
Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported
15,90	13,78	29,68	2,65	7,95	10,60	0,28	0,28	0,55

Table 6 Nutrient export

Bor			Fier		
Seeds	Vegetable waste	Total exported	Seeds	Vegetable waste	Total exported
0,08	0,74	0,82	0,60	0,58	1,18

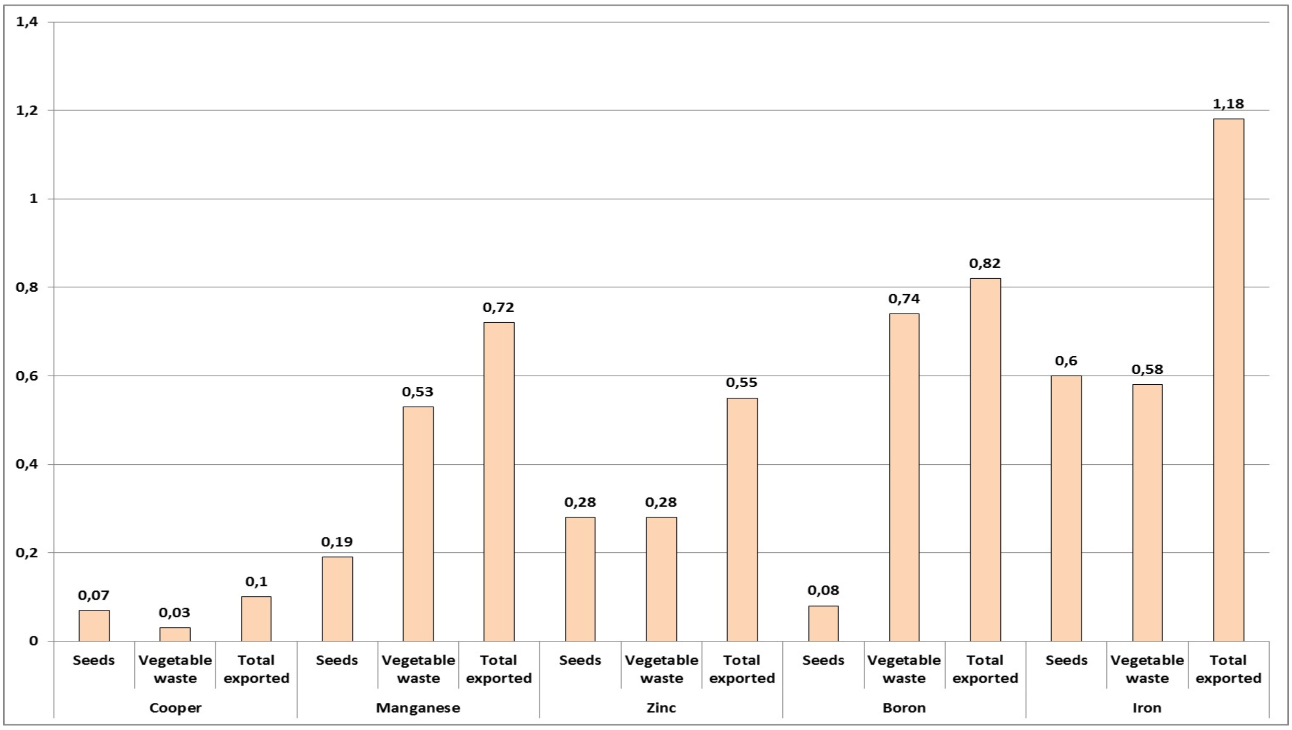


Figure 4 Nutrient export

Fertilization recommendations:

-N (Kg s.a./ha) – 130,13;
- P_2O_5 (Kg s.a./ha) – 97,00;
- K_2O(Kg s.a./ha) – 80,00;
- Ca_2CO_3(Kg s.a./ha).

Observations – Complexes + nitrolimace minimum 150kg/ha

Chemical fertilization for Wheat and Rapeseed
Phosphorus and Potassium are applied in full in autumn. In autumn, before plowing, complex fertilizers 20:20:0 are applied, in a quantity of 250 kg/hectare, then, before sowing, complexes 20:20:0, 100 kg/hectare will be administered.
Simultaneously with sowing, starter fertilizers (microgranulated) are applied in a quantity of 20 kg microgranulated fertilizers/hectare. In winter, 150 kg Nitrolimace is applied. In spring, when the snow melts, 150 kg Nitrolimace will be administered/hectare, and after 3 weeks, another 150 kg Nitrolimace will be applied/hectare.
Nitrolime will be used for 4 years on these soils.
To obtain a healthy and productive rapeseed crop, it is essential to ensure favorable soil conditions. A series of fundamental aspects must be taken into account for a rigorous assessment, namely:
-Soil pH: Rapeseed prefers a pH between 6 and 7. If the pH is lower, lime can be applied to correct it.
-Fertilization: The soil must be well fertilized. Rapeseed needs nitrogen (N), phosphorus (P) and potassium (K). It is

important to carry out a soil analysis to determine the nutrient requirements.
Recommended:
Nitrogen: 40-120 kg/ha, depending on the type of soil and growing conditions.
Phosphorus: 30-60 kg/ha, depending on the phosphorus content of the soil.
Potassium: 30-80 kg/ha, depending on the crop requirements.
Adding organic matter, such as compost or manure, can improve soil structure and water holding capacity.
The soil must have good drainage, as rapeseed does not tolerate excess water.
A well-structured soil with good aeration is essential for root development.
Practicing crop rotation can help prevent disease and maintain soil fertility.
Regularly monitoring the crop to identify and control pests or diseases that may affect rapeseed.
By ensuring these conditions, the soil will be favorable for the rapeseed crop and will contribute to obtaining good harvests.
Rapeseed (Brassica napus) is an oilseed crop that grows on a variety of soil types, but it particularly prefers soils that have good water retention capacity and adequate fertility. Rapeseed also does well on slightly acidic to neutral soils with a pH between 6 and 7.

CONCLUSIONS

The climatic and pedological analysis of the researched perimeter reveals a favorable framework for the development of agriculture, but it is essential to take into account both natural characteristics and anthropogenic interventions. The forest-steppe area, with its specific vegetation, provides a good base for agricultural crops, but the compact state of the upper soils, caused by pedogenetic processes and inappropriate interventions, requires improvement measures.

Deep loosening works are essential to improve the soil structure and facilitate the circulation of air and water, thus contributing to increasing fertility. The soil quality assessment was carried out with the aim of identifying the necessary interventions, such as damming, drainage and combating salinity, to optimize plant growth conditions.

In order to maximize the productive potential of the soil, an integrated approach is recommended, combining hydro-ameliorative measures with agro-pedo-ameliorative measures.

This involves ensuring an optimal aerohydric regime in the soil and adapting cultural technologies to local specifics. Also, the introduction of new conservation technologies can improve the resilience of the agricultural system to climate variability.

Therefore, although climatic conditions are favorable for the cultivation of agricultural plants, it is crucial to monitor deviations from the multiannual average of temperatures and precipitation. The implementation of appropriate agrotechnical measures will contribute to correcting these deviations and maintaining sustainable and productive agriculture in the area.

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