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ECOPEDOCLIMATIC ASSESSMENT AND AMELIORATION MEASURES FOR THE SOILS IN THE NORTHWESTERN PART OF TIMIȘ COUNTY

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Abstract. *The purpose of this work is the ecopedoclimatic assessment of the Sânpetru Mare area (NV Timiș) in order to develop improvement measures (agrotechnical, agrochemical, hydrotechnical) and improve soil productivity. The sustainable development of agriculture is a strategic priority, being directly conditioned by the quality and health of soil resources. In this context, the efficient management of agricultural land requires a deep understanding of the factors that influence soil productivity. The northwestern area of Timiș County, including the Sânpetru Mare locality, is part of an area with high agricultural potential, but which, in places, faces pedological and climatic limitations. The main limiting factors of the productions obtained on these soils are soil acidity and generally poor supply of humus and mineral nutritional elements. The practice of sustainable agriculture here requires a balance between soil degradation and regeneration processes, of great importance for these pedo-agrochemical conditions, and solutions for protecting and restoring fertility must lead to efficiency, quality and conservation of soil resources. The practice of restoring the fertility of acidic soils has proven that the two specific measures – amendment and rational fertilization – are effective actions for the reconstruction of acidic soils and these two measures mutually enhance their effects. Obviously, amendment by correcting the reaction creates a physico-chemical environment favorable to plant growth, but fertilization uses the newly created favorable environment for restoring fertility, increasing productivity and protecting soils, so fertilization determines a harmonization of the requirements of plant crops with a newly created and improved environment, in terms of nutritional conditions.*

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Keywords*: ecopedoclimatic assessment, improvement measures, soil productivity*

INTRODUCTION

The North-West part of Timiș County is part of the Western Plain (Lower Timiș Plain and the south of the Tisa Plain). (OKROS ADALBERT, 2015)

Relief - the low plain predominates, with low altitudes, characterized by microreliefs created by old water courses and fluvial-lacustrine depression areas. The smooth relief favors agricultural work, but predisposes to water stagnation in the absence of adequate drainage. (Lucian Dumitru NIȚĂ, 2023, Lucian Dumitru NIȚĂ, 2024)

Climate - is specific to the transitional temperate-continental climate, with mild influences (sub-Mediterranean) that manifest themselves through less frosty winters and warm summers. The pluviometric and thermal regime, along with the relief, strongly influences the water balance of the soil. (ANIȘOARA DUMA COPCEA, ET. AL. 2024).

The soils in this area are generally derived from loessoid and alluvial deposits, being considered, for the most part, fertile. (IANOȘ, GH., ET.AL. 1994)

Dominant soil types: - chernozems and phaeozems (highly fertile soils) are frequently found, along with eutric cambisols and, in river meadows, alluvial soil. (KAREL IAROSLAV LAȚO, ET.AL, 2022)

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Agricultural potential - due to the high chemical fertility of many types of soils and the favorable climate, the area has an excellent productive potential for field crops (wheat, corn, sunflower, soybean). Despite the potential, optimal exploitation of the land is hampered by persistent problems that require improvement. These are the main focus of the ecopedoclimatic assessment. ((NICOLETA MATEOC-SÎRB, 2025, DAVID, G., ET.AL. 2018)

Poor aerohydric regime: - represents the most serious problem, caused by poor natural drainage and heavy rainfall in certain periods, leading to excess moisture and root asphyxiation.

Salinization and sodization: - in areas with poor drainage and phreatic influence, salt and sodium accumulation processes occur, leading to the formation of saline soils (solonetz), whose fertility is drastically reduced.

Acidification and nutrient imbalances: - in some places, an acidic reaction of the soil is recorded that blocks the assimilation of phosphorus and other essential microelements.

Anthropogenic compaction: - the use of heavy machinery leads to the compaction of the arable and sub-arable layer, affecting water infiltration and root development.

Timiș County, part of the Western Plain of Romania, is notable for its valuable land. However, the natural fertility of the soils in the northwestern part of the county is often limited by a series of specific pedoclimatic factors, requiring specialized interventions. (NIȚĂ, L., ET. AL. 2018, NIȚĂ, L., ET AL 2019, BLAGA, GH., ET EL. 2008).

The detailed ecopedoclimatic assessment of these lands aims to identify the main limiting factors that affect the productive potential of the soils — from the deficient aerohydric regime, to salinization/sodization processes and to acidity or compaction problems.

Soil quality deterioration has negative repercussions, either on one or on all soil functions. Therefore, it is necessary to quantify the impact of soil quality degradation, both for its current use and for a sustainable use. The impact of soil degradation is determined by the combination of soil vulnerability, the “pressure” exerted by a certain land use or a certain technological work applied (fertilization, control, mechanical work).

Ameliorative measures aim to eliminate limiting factors and increase the land use class. The transition towards high-performance agriculture, based on principles of economic and ecological sustainability, is aimed at.

MATERIAL AND METHODS

The soils of the studied area have a series of common characteristics:

-they are based on the same parent rock, formed by alluvium and loess;

-they are in a medium stage of evolution;

-they contain a high percentage of easily soluble salts.

From the agricultural area of 18,836 ha of the locality, based on data obtained and processed from the archive of the O.S.P.A. Timişoara, respectively from the Pedological Study of the UAT Sânpetru Mare, the following soil types were identified:

1. Alluvial soils, 2335.66 ha, respectively 12.4% of the total;
2. Chernozems, 7553.24 ha, i.e. 40.01%;
3. Vertosols, 4407.62 ha, respectively 23.40%;
4. Gleiosols, 94.18 ha, 0.50%;
5. Solonets, 659.26 ha, or 3.50%.
6. Soil associations, such as: alluviosols, chernozems, vertosols and solonets, 3786.04 ha, or 20.10%.

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Table 1.

The types of soil existing in the commune of Sânpetru Mare

Nr. Crt.	Soil type	Area	
		ha	**%**
1.	Alluvial soils	2335,66	12,4
2.	Chernozems	7553,24	40,01
3.	Vertosols	4407,62	23,40
4.	Gleiosols	94,18	0,50
5.	Solonets	659,26	3,50
6.	Soil associations	3786,04	20,10

From an agricultural point of view, alluvial soils are easy to work and very productive, with the exception of those that are salinized and excessively affected by groundwater.

The agricultural land of the commune consists of the following uses:

-arable 15539 ha (85.9%);

-pastures 3110 ha (13.8%);

-hayfields 167 ha (0.2%);

-vineyards and orchards (vineyards - 9 ha, orchards - 11 ha (0.1%).

Regarding the classification in quality classes, for the "arable" use category, the situation is as follows:

- class I 3128 ha (20.13%);
- class II 4635 ha (29.83%);
- class III 5218 ha (33.58%);
- class IV 1474 ha (9.49%);
- class V 1084 ha 6.97%).

The main limiting factors that influence the quality of these soils are represented by the following properties:

- excess groundwater moisture (moderate 20%, strong-excessive 9%);
- excess rain moisture (weak 37%, moderate 6%, strong-excessive 2%);
- compactness (low 27%, moderate 10%);
- salinization (weak 48%, moderate 7%, strong-excessive 14%);
- reduced bearing capacity (8.36%);
- low humus reserve (12%);
- soil reaction (weakly acidic 60%, moderately acidic 28%).

The improvement and valorization of the productive potential of agricultural lands in this area can be achieved under the conditions of an integrated approach of hydro-ameliorative measures with current agro-pedo-ameliorative and cultural ones, which will aim to ensure an aerohydric regime in the soil within the optimal parameters of functionality.

The rehabilitation and modernization of irrigation works, the modernization of defense works, embankments and drainages should constitute a priority in the ecological reconstruction programs of soils and agricultural holdings in this area.

The improvement and valorization of the productive potential of the land can be achieved under the conditions of an integrated approach of hydro-ameliorative measures with current agro-pedo-ameliorative and cultural measures that will aim to ensure an aero-hydric regime in the soil at optimal functionality parameters, as well as by introducing new technological systems for conservation and adaptation of current cultural technologies to the specific pedoclimatic conditions (varieties, hybrids).

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RESULTS AND DISCUSSIONS

The work was carried out on an area of 86 ha on an existing farm in the commune of Sânpetru Mare, Timiș county.

Table 2

Crops in the commune of Sânpetru Mare

Crop	Area – ha
Wheat	1900
Corn	1100
Sunflower	365
Barley	344
Oats	25
Triticale	85
Forage crops	200
Total	4019

Table 3

Harvested area and production obtained

Nr.crt.	Crop	Harvested area (ha)	The production obtained (t)
1	Wheat	1713	6100
2	Corn kernels	1183	2860
3	Sunflower	298	506
4	Barley	268	520
5	Triticale	20	30
6	Forage crops	390	6560

Table 4

Cultivated area and production of fodder plants

Crop	Harvested area (ha)	The production obtained (t)
Forage plants-total	290	
-alfalfa for hay and green mass-total (green mass equiv.)	190	3078
-clover for hay and green mass-total (green mass equiv.)	50	700
-other perennials for hay and green mass-total (green mass equiv.)	50	600
-silage plants-total:	12	168
maize for silage-total	12	168
Natural pastures in use (in green mass equiv.)	667	8034

Table 5

Cultivated area and cereal production

Crop	Harvested area (ha)	The production obtained (t)
Common winter wheat	1953	11920
Common spring wheat	21	105
Winter triticale	35	161
Barley	180	846
Winter barley	9	36
Spring barley	1	4
Winter oats	20	86
Grain corn	1328	11421

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Table 6

Cultivated area and production of fodder plants

Crop	Harvested area (ha)	The production obtained (t)
Forage plants	201	4065
Old and new perennials (green mass equiv.)	19	
-in own field	192	3840
-alfalfa for hay and green mass (green mass equiv.)	186	3720
Plants for silage -corn for silage	9	225
Perennial grasses-seed	5	4
Natural pastures in use (in green mass equiv.)	667	3000
Natural hayfields in use (in green mass equiv.)	8	36

LIMITING FACTORS AND MEASURES TO PROTECT THEM

Qualitatively, the soils in the researched area are influenced by the following limiting factors:

- excess groundwater moisture (moderate 20%, strong-excessive 9%);
- excess rain moisture (weak 37%, moderate 6%, strong-excessive 2%);
- compactness (reduced 27%, moderate 10%);
- salinization (weak 48%, moderate 7%, strong-excessive 14%);
- reduced humus reserve (12%);
- soil reaction (weakly acidic 60%, moderately acidic 28%).

I believe that one of the priorities of the ecological reconstruction programs of soils and agricultural holdings in the presented perimeter should be the restoration and modernization of irrigation works, modernization of defense works as well as embankments and drainage.

After analyzing the existing characteristics in the studied area, I can conclude: chernozems can be cultivated with a wide range of crops (cereals, technical plants, vegetables, trees and vines). The productions obtained are high and qualitative. The effective fertility of these soils is reduced due to the deficient precipitation regime during the vegetation period.

The recommendation for increasing fertility on these soils is the application of a complex of measures such as:

-agrotechnical works - which lead to the accumulation and maintenance of water in the soil;

-periodically apply organic and mineral fertilizers based on NPK;

-monoculture should be avoided;

- implementing a crop rotation;

- completing the moisture deficit through irrigation (especially when growing plants that require high water consumption, such as: sugar beet, corn, vegetables, etc.).

Regarding vertosols, regardless of the existing crops, they suffer from a lack of water or excess moisture.

The aerohydric regime on these soils is improved by taking the following measures:

performing deep soil works;

the works are carried out during optimal periods of moisture;

performing drainage works;

- using organic and mineral fertilizers.

The Gleiosols in Sânpetru Mare are occupied by meadows and hayfields of medium quality.

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To increase the fertility of these soils, it is necessary to take some improvement measures such as: digging drainage channels maintaining the groundwater level at 2.0 - 2.5 m, thus ensuring a favorable aero-hydric regime. Applying manure once every 2-3 years.

If such measures are put into practice, Gleiosols can be cultivated with the following crops: potatoes, wheat, rye, sugar beet, etc.

Barley crop

To establish this crop, scarification was carried out to a depth of 40 cm, using the Pinocchio scarification machine from Maschio Gaspardo.

The seedbed was prepared by discing to a depth of 10 cm with the Konig agricultural disc.

Fertilization was done with 180 kg of commercial product DAP 18:46:0 with the Strumyk disk fertilizer distributor.

Sowing: 400-500 germinated grains per square meter were sown with the Kverneland seeder at a depth of 3-5 cm. The hybrid used was Jallon Syngenta.

Fertilization was done in the spring using 200 kg of urea

Harvesting was done with the New Holland CX 840 combine. 6,600 kg/ha were harvested.

WHEAT crop

The preparation of the germinated bed was done with the Taurus disc harrow with the Paker roller at a depth of 8-12 cm.

Fertilization was done with 200 kg of commercial product with the Strumyk disk fertilizer distributor.

Sowing: 550 germinated grains were sown per square meter with the Kverneland seeder at a depth of 2-4 cm. The hybrid used was Hystar from Saaten Union.

Fertilization was done once using 200 kg of urea through the Strumyk fertilizer distributor.

The second fertilization was done with 100 kg of urea through the Strumyk fertilizer distributor.

Harvesting was done with the New Holland CX 840 combine. 7,300 kg/ha were harvested.

CORN culture

-Stubbled- the work was done with the Taurus disc harrow at a depth of 8-12 cm.

-Fertilization was done with 180 kg of DAP through the Strumyk fertilizer distributor

-Scarification was done at a depth of 40 cm.

-Fertilization was done with 200 kg of urea.

-Spring superficial preparation: - a discing was done at a depth of 10 cm.

-Sowing - the KWK Smaragd hybrid, FAO 350, was used, using 70,000 grains per hectare. The sowing depth was 6 cm, using the Maschio Gaspardo seeder on 6 rows.

-Harvest - 7000 kg/ha were harvested.

SUNFLOWER culture

Stubble cultivation - the work was carried out with the Taurus disc harrow at a depth of 8-12 cm.

-Fertilization was carried out with 180 kg of DAP through the Strumyk fertilizer distributor

-Scarification was carried out at a depth of 40 cm.

-Fertilization was carried out with 100 kg of urea.

-Spring superficial preparation: - a discing was carried out at a depth of 10 cm.

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-Sowing - the Paraiso 102 Saaten Unuion hybrid was used, using 50,000 grains per hectare. The sowing depth was 6 cm, using the Maschio Gaspardo seeder on 6 rows.

-Harvested - 3,700 kg/ha were harvested.

CONCLUSIONS

The studied lands in the commune of Sânpetru Mare, Timiș county have several common characteristics, namely: the parent rock is the same, formed by alluvium and loess; it has an average evolution stage; easily soluble salts with a high percentage.

Studies and practical observations indicate the presence of degradation processes or inherent deficiencies of the soil (such as salinization, compaction or nutritional imbalances) which, in interaction with the thermal and water regime specific to the area, can significantly reduce natural fertility and, implicitly, crop yield.

In order to overcome these challenges, it is necessary to carry out a detailed ecopedoclimatic assessment of the lands in Sânpetru Mare, in order to identify and quantify the existing limitations.

Improving and highlighting the productive potential of the land can be achieved - if hydro-ameliorative, agro-pedo-ameliorative but also current cultural measures are taken that aim to ensure an aerohydric regime in the soil that operates at optimal parameters; but also by using new technological systems for conservation and changing existing cultural technologies specific to pedo-climatic conditions, varieties, hybrids.

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