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USING SOIL SCIENCE INFORMATION TO ESTABLISH AGRICULTURAL LAND FAVOURABILITY IN BANAT (ROMANIA)

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Abstract - Using soil science information to establish agricultural land favourability in Banat
The goal of our research was to gather scientific data concerning soil chemical, physical, and hydro-physical features necessary to develop a soil favourability assessment methodology through a complex approach of the physicogeographical and climate-edaphic conditions of the Banat area (Romania). The importance, originality, and modernity of this paper consist in the need to protect the edaphic cover and the environment by:

- gathering scientific data necessary to set the bases of a soil quality assessment methodology, in particular, and of the environment, in particular, through a complex approach of the physicogeographical and climate-edaphic conditions of the Banat area;
- gathering scientific data necessary to set the bases of a technology for the conservation of the edaphic cover and for the sustainable management of soil and water resources in the Banat area.

All this concerns an area of 1,832,894 ha, of which 1,194,301 ha are agricultural lands in Western Romania. Cadastre is, in the economic and strategic equation of a country, a very important constant, that warrants ownership rights on assets and determines their heritage value, which justifies the necessity and modernity of land assessment activities.

Keywords: **factors, relief, hydrography, soil, cadastre**

INTRODUCTION

Identifying and defining in space each plot and establishing its topographic identity – area, latitude, longitude, altitude, slope, exposition, and relief defined morphologically and genetically – plays an important role in defining the ecological conditions for plant growth (cultivated or spontaneous). Due to its geographical location, the land under study – situated in the middle of the northern hemisphere between 44°27' and 47°35' latitude and between 20° 15' and 22°52' longitude – has a wide range of ecological conditions determined by the wide variety of all the factors (cosmic-atmospheric and telluric-edaphic) making up the environment in which the plants grow and yield. In the present socio-economic and political conditions in which Romania hopes to find its place among civilised EU nations, we need to better know our offer in both absolute and relative values.

As far as south-western Romania is concerned, systematic soil and agro-chemical studies carried out by the OSPA Timişoara during several cycles (5-6), together with long-lasting ASAS and INCDPAPM fertiliser experiments and with occasional research concerning soil quality and environmental pollution, show a steady degradation of soil quality and the dependence of agriculture on the imports of materials and energy from the industry.

The research carried out is part of the foundation of a sustainable agriculture system meeting domestic demands for a scientific database necessary to set the bases of a technology and to develop measures for the integrated management of agro-ecosystems (BORZA ET AL., 2002; FLOREA ET AL., 1987).

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MATERIAL AND METHOD

We have focused on an area of 1,832,894 ha, of which 1,194,301 ha agricultural lands, an area located in western Romania and representing a number of cadastre areas in the following counties: Arad, Timiş, Caraş-Severin and Mehedinţi (covering the historical province Banat and some neighbouring areas) (Table 1).

Table 1: Land structure for main land use categories

County	Arable	Grassland	Hay-making fields	Vineyards	Orchards	Total agricultural lands	Forests	Other categories	Total
Timiş	530,215	129,231	29,313	4,313	9,326	702,398	109,017	58,25	869,665
Caraş-Severin	127,445	182,836	75,990	1,157	12,192	399,620	409,864	42,492	851,976
Arad	64,270	15,600	4,573	232	1,805	86,480	31,015	1,000	118,495
Mehedinţi	1,211	2,277	2,218	22	75	5,803	43,500	1,705	51,008
Total (ha)	723,141	329,944	112,094	5,724	23,398	1,194,301	593,396	45,197	1,832,894
%	39.45	18.00	6.12	0.31	1.28	65.16	32.37	2.47	100.00
%	60.55	27.63	9.39	0.48	1.96	100.00	-	-	-

The characterisation of eco-pedagogical conditions, the definition of soil and land units, as well as the analysis of the limitative and restrictive factors of land quality were done in accordance with the „Methodology of Carrying out Soil and Agro-chemical Studies" (vols. I, II, and III) developed by the ICPA Bucureşti in 1987, and completed with elements from the Romanian Soil Taxonomy System (SRTS-2003).

RESULTS

The relief, on the whole, is characterised by a wide complexity of morphological forms, flooding meadows and old deltas (with numerous relic water courses and altitudes of about 86 m), to semi-drained plains (overlapping large spreading cones set on an area with altitudes of 80-100 m), piedmont plains (with alluvio-proluvial or Aeolian deposits), plateaus and piedmonts, high hills, sub- and intra-mountain depressions, as well as mountains measuring up to 2291 m (the Gugu Peak in the Godeanu Mountains), with specific geological structures and pedo-geographical evolutions related to the genesis in time and space of western Romania. Thus, tectonic elements lead to the indentation of the mountains along faults and crests, phenomena contoured steadily by the permanent subsistence of the areas in the middle of the Pannonia Depression.

Over this sequence with a difference of almost 2200 m, the relief in south-western Romania has the shape of a grandiose and harmonious amphitheatre, open towards north-west and subjected to permanent changes both under the impact of natural factors and, particularly, under the impact of man who has changed it more significantly than in other areas of Romania.

The hydrographical network, represented by rivers, lakes, and a complex system of canals for desiccation and irrigations with basins south and north from the Mureş River, belonging to the Danube basin, as direct tributaries of the Tisa River (Aranca, Bega) or of the Danube River (Timiş, Cena), gathering its water exclusively from the province territory, the only domestic water courses being the Mureş and the Danube.

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They are closely tight to the mountain and sub-mountain area because of their sourcing there; it is also there that the features of liquid flowing processes are defined. Thus, in the mountain area, the density of the hydrographical network is 0.56-0.62 km/km^2, in the piedmont areas is it only 0.30-0.40 km/km^2, while in the low plain area, it is almost absent (0.10-0.20 km/km^2), being substituted, in time, by a network of irrigation and desiccation canals grouped in complex hydro-ameliorative systems.

The most important rivers that drain the perimeter under study organising well individualised hydrographical basins are: Aranca, Beregsău, Bega, Timiş, Bârzava, Moraviţa, Caraş, Nera, Cena and, partially, Mureş and the Danube. Due to its geographical position, the area under study is characterised by the existence of a moderate continental climate with ocean influences, the highest frequency being that of the following types of air masses:

- polar-maritime, with a very high frequency in summer and at the end of spring, moved by the western and north-western circulation and having a cold and moist character;
- polar-continental, cold and dry in winter, hot and dry in summer, and penetrating through north-eastern and eastern circulation;
- tropical-maritime, reaching the area from the south and south-west, through the dorsal of the Azores anti-cyclone, determining, in winter, a soft weather, and, in summer, an unstable weather;
- arctic-maritime, carried from North Atlantic within polar circulation and determining, in winter, a frosty and moist weather, as well as late defrosting in spring and early defrosting in autumn;
- tropical-continental, carried by the circulation from the south, south-west, are more frequent in the hot season, when they engender tropical days and nights;
- arctic-continental, with the lowest multi-annual frequency, more frequent in winter, when they determine hard, dry frosts periods of time.

As important ecological factor determining the geographical distribution of certain species and influencing basic physiological processes – such as photosynthesis, respiration, transpiration, succession of phenol-phases, development of the root system, micro-organism activity, gas exchange, and nutrient absorption, etc. – it varies, in its turn, depending on geographical location, latitude, altitude, soil morphological, mechanical, physical, and chemical features, as well as the degree of coverage or the type of working. The territory under study, situated between 44°27' and 47°35' northern latitude and 20°15'-22°52' eastern latitude has almost no differentiation between north and south (below 0.3°C/1° latitude), while between western and eastern parts the differences of about 12°C are due mainly to altitude differences of about 2100 m, i.e. a decrease of 0.6°C for each 100 m of altitude.

Thus, in the studied area, the gradual disposition of the relief determines the vertical and horizontal distribution of all environmental elements, reflected in the distribution and grading of vegetation in the low plain areas in south and south-west, thus distinguishing steppe and sylvo-steppe followed by the area of plain, hill, and mountain area forests with associations of *Quercus* species, beech, and resinous, and, on mountain tops, by alpine and sub-alpine pastures.

Representing a well defined environmental condition, with a wide variability in the space, soil factors play, due to their components, an essential role in defining and characterising a certain portion of the dry land.

Soil, as the main element of agro-systems, can favour their productivity through a series of specific features, well defined and studied in time, such as: amount, quality

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and balance of nutrients, useful edaphic volume, texture, porosity, permeability, air-hydric and thermal regimes, mineralogical composition, reaction and base saturation.

According to the Romanian Soil Taxonomy System (SRTS 2003), we identified, in the studied area, 11 classes of soils, 23 types of soil (Table 2, Figure 1), 107 sub-types, 300 soil units and numerous detailed units that distinctly differ due to their features, their yielding capacity, and the maintenance and fertility increasing measures.

Table 2: Types of soil

Nr.	Type/sub-type of soil WRB-1998	Agricul-tural	Arable	Grass land	Hay making field	Vine yards	Orchards
		%	%	%	%	%	%
1	Leptosol	2.76	0.01	6.36	10.57	-	0.15
2	Regosol	4.50	0.02	13.65	5.56	3.44	9.17
3	Arenosol	0.10	0.14	0.06	0.01	0.15	0.03
4	Fluvisol	7.93	8.50	6.39	10.48	1.17	1.49
5	Cernoziom	12.64	19.50	2.04	1.22	19.05	2.95
6	Phaeozem	3.46	5.30	0.20	1.24	1.50	3.46
7	Rendzic Leptosol	0.26	-	0.56	0.81	-	1.20
8	Humic Cambisol	0.22	-	0.80	-	-	-
9	Dystric Cambisol	0.20	-	0.74	-	-	-
10	Eutric Cambisol	10.91	10.26	11.08	15.86	3.69	6.63
11	Dystric Cambisol	12.66	7.60	21.88	21.11	-	1.92
12	Halpic Luvisol	12.70	18.12	3.78	2.25	11.28	21.21
13	Luvisol	13.70	15.30	9.80	8.98	12.70	42.14
14	Planosol	0.44	0.50	0.37	0.21	0.35	0.87
15	Cambic Podzol	0.22	0.11	0.54	-	-	-
16	Halpic Podzol	0.37	0.30	0.68	-	-	-
17	Vertisol	8.01	8.06	10.00	3.42	0.40	2.23
18	Gleysol	5.28	4.12	5.14	14.52	-	-
19	Stagnic Luvisol	0.80	0.49	1.00	2.45	-	-
20	Solonetz	1.78	1.02	3.93	0.85	-	-
21	Histosol	0.03	-	0.12	-	-	-
22	Erodosol	0.60	0.51	0.52	0.11	11.64	3.96
23	Anthrosol and Entiatroposol	0.43	0.14	0.36	0.35	34.63	2.59
Total		100	100	100	100	100	100

To know more in detail the 300 land units (T.E.O.), i.e. the ecopedological characterisation of the lands in order to establish their yielding capacity, we kept in mind that the entire activity of growing and producing vegetables is carried out under the influence of vegetation factors and of unchanged or man-changed environmental conditions in different degrees, depending on the increasing man's capacity of changing things (ȚĂRĂU D., GERGEN I., ROGHOBETE GH., BONANS E., BRIES I., 2000).

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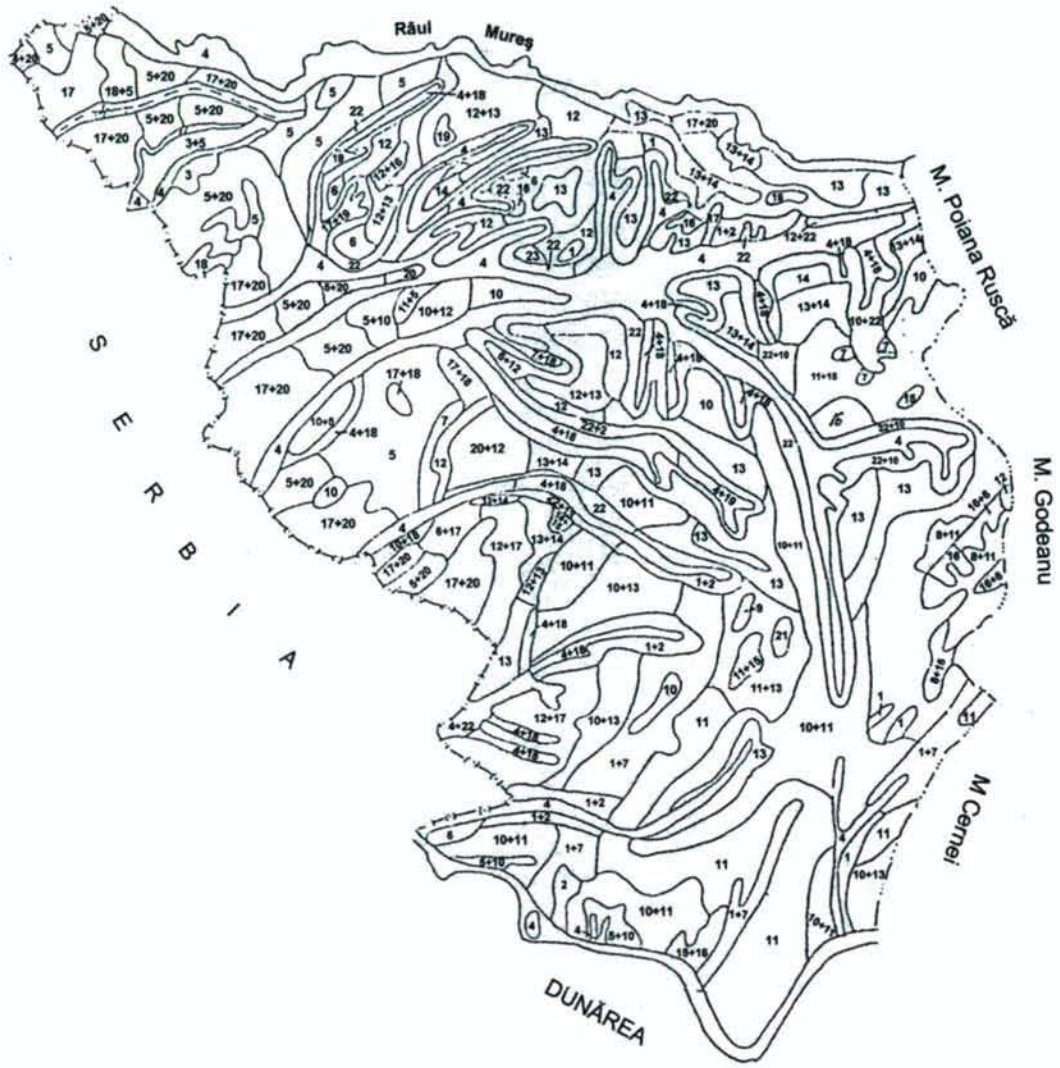

Figure 1: Map of Banat soils

Starting from the classical Romanian methodology (TEACI 1980; I.C.P.A. BUCUREŞTI 1987) and using a conventional Pascal calculus programme (adapted after a SPED 1 programme developed by ŢĂRĂU D., MARTON GH., RACOVICEAN M., TRETA D., 2005) organised in three levels containing multitudes of possible values possible over intervals of manifestation of each of the 23 indicators, as well as their interactions, real values that characterise both natural and anthropic features of each of the 300 ecological lands within the studied area, and the situation of the areas of each of the lands characterised, we obtained assessment grades (from 1 to 100) for the entire studied territory and for each type of soil.

This desideratum, in its turn, asks for a detailed knowledge of the ecological offer defined generically as the totality of the natural factors whose varied structural complexity is necessary for the genesis of the development and maintenance of abiotic and biotic systems through a harmonious balance between soil improvement and plant improvement in agreement with their production measures.

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CONCLUSIONS

The development of a technology that ensures ecological balance needs to be based on results from research carried out in time concerning the sue of fertilisers, of amendments, and of crop rotations, etc., set in soil and climate units specific to the Timiş County, and that are managed by institutions representative for research and education such as: the Banat University of Agricultural Science and Veterinary Medicine in Timişoara, S.C.D.A. Lovrin, O.S.P.A. Timişoara, and S.C.D.A. Oradea.

The land assessment and technological characterisation studies supply precious information concerning the land eco-pedological state, assessment, and evolution of quality.

In the economic and strategic equation of a country, cadastre is a particularly important constant that guaranties the ownership right on assets and determines their heritage value, which asks for and justifies the necessity of mapping, surveying, and assessing the lands.

The modernity of the mapping, surveying, and assessing of the lands also results from the fact that land, besides its features as historical and natural body, is the most important means of production in agriculture and sylviculture, an asset that is subjected to ownership and, implicitly, an exchange item on the market, that has a certain use value.

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