

RESEARCH ON THE ECO-PEDOLOGICAL BASIS OF AGRICULTURAL LAND PRODUCTIVITY FROM THE BANAT LOW PLAIN (MURES-BEGA INTERFLUVE)

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Abstract. *The research goal is the accumulation of scientific data on the ecological and soil conditions necessary to support the agricultural land productivity to promote agricultural practices that use in a sustainable way the edaphic cover from the investigated area. The objectives and activities fall within the current agricultural research and agricultural practice, on international and national level, for the study of the relations between soil conditions and the productivity of agricultural land. The importance, originality and timeliness of work consists in the need of knowledge of environmental and soil conditions, this causing major strands of rural development, of edaphic cover and environment protection. Given these considerations, the author of this paper tries to present some aspects concerning the use of soil information in promoting environmentally friendly farming practices. Following its settlement, the natural conditions (relief, lithology, hydrology, vegetation) are specific to a low subsidence plain, ramble and build where they formed and evolved main soil types with specific forms of micro-relief features. Each of the soils identified within the area studied were characterized according to Soil Studies Elaboration Methodology (Vol. I, II, III) using the 23 indicators of evaluation, indicators and features are most important characters, more significant, more precise and easier measurable, which is usually found in soil studies and research work developed by OSPA territories after 1987. The paper offers basic knowledge and methodological elements for evaluation and characterization of the natural and anthropogenic resources, in the hope that the information presented will arouse interest of the decision maker so in the near future agricultural research and practice with environmental protection, to strive for development interdisciplinary studies, not being able to talk about a healthy environment without a healthy soil. Such detailed knowledge of productive and technological characteristics of the contributing, restrictive or limiting factors of agricultural production, both in terms of the actual event and in terms of real possibilities for modifications, may be better for decision-making bodies (government, administration local) a valuable tool for achieving the most appropriate practical measures for the benefit of plant biomass production to improve its conditions of human life and the entire community.*

Keywords: *biodiversity, yield, crops, durability, evaluation*

INTRODUCTION

The natural conditions in the studied area are favorable for development of agro-food sector in all aspects. There is an old tradition of cereals cultivation and their utilization by livestock and especially by swine breeding. Until 15 to 18 years ago, the share (in agriculture) of animal farming in Timis county was 60% and 89% of that was represented by the intensive pig farming sector.

Territorial distribution of farms was completely inappropriate, pig farming was concentrated on only half of the county, mainly in the low plain areas, characterized by high level of groundwater (0.5 to 4.0 m), which was controlled by a network of drainage channels (BORZA et al., 2001).

In recent years, following the privatization of former COMTIM holding, the livestock decreased.

This decrease of the number of animals from Banat and in general from the country has generated, on the one hand, a shortage of meat (offset by imports) and, on the other hand, difficulties in using of cereals. In these conditions, increased investor appetite for livestock development, especially the pig, for which there is a tradition.

In these conditions, it increased the investor appetite for livestock development, especially the pig sector, for which there is an old tradition.

It is now important the choice of development strategy, which must be consistent with the interests of public view, but also in line with common European future (DUMITRU, 2000; TEACI, 1995; ȚĂRĂU, 2002).

MATERIAL AND METHODS

The study it refers to an area of 228,407.00 hectares from which 202,920.00 ha of agricultural land (Table 1).

Table 1

Areas structure for the main land use in Banat low plain (1.01.2007, ha)

No.	Place	Arable	Pasture	Hayfield	Vineyard	Orchard	Agriculture total	Forest	Water	Others	General Total
1	Beba Veche	7793	976	3	16	30	8818	4	216	367	9405
2	Biled	8853	972	16	3	1	9845	0	242	605	10692
3	Becicherec	7126	1628	583	6	1	9344	8	277	429	10058
4	Cărpiniș	7022	343	0	20	14	7399	2	160	524	8085
5	Cenad	6504	728	43	4	104	7383	366	242	500	8491
6	Cenei +Checea	10178	1304	154	1	7	11644	14	227	646	12531
7	Comloșu M.	8203	495	3	18	5	8724	8	182	565	9479
8	Dudeștii V.	16257	2715	36	40	14	19062	18	564	920	20564
9	Jimbolia	8990	725	12	9	9	9745	6	234	876	10861
10	Lenaheim	10087	404	17	12	0	10520	2	166	587	11275
11	Lovrin	11339	138	6	13	223	11719	34	79	802	12634
12	Periam	7653	749	37	4	600	9043	74	144	572	9833
13	Sănnicolau M	10668	1607	47	12	355	12689	36	320	858	13903
14	Sămpertu M.	15539	3084	154	8	11	18796	201	561	848	20406
15	Sănmihaiu R	5344	1137	362	4	4	6851	10	225	440	7526
16	Săcălaz	9347	1282	187	4	7	10827	1	356	765	11949
17	Timișoara	7060	426	224	39	84	7833	649	318	4127	12927
18	Teremia M.	6641	625	28	453	2	7749	8	141	468	8366
19	Variaș	9485	722	157	1	1	10366	1	148	652	11167
	Timi County	174089	20060	2069	667	1472	198357	1442	4802	1551	220152
20	Felnac	599	58	4	3	1	665	429	96	320	1510
21	Secusigiu	3525	250	123	0	0	3898	1601	428	818	6745
	Arad County	4124	308	127	3	1	4563	2030	524	1138	8255
	General total	178213	20368	2196	670	1473	202920	3472	5326	16689	228407

The research of ecopedological conditions, ordering and data processing was done in accordance with the Developing of Pedological Studies Methodology (vol I, II, III), developed

by ICPA Bucharest in 1987 and the Romanian System of Soil Taxonomy (SRTS-2003, FLOREA, 1987, 2003).

RESULTS AND DISCUSSIONS

The geological past of researched area is connected with the past of Banato-Cri ana Plain, being one of the east part of the great basin of sedimentation called Panonic Depression (IANOS, 1994).

The forming of plains from investigated space is strongly connected to base level of Panonic Depression from Middle Danube area, to varied rivers that comes from mountains, thing that had determinate the evolution of two groups of plains: high plains (situated near hills) and low plains (situated near Tisa).

Low plains start at an altitude of about 90-110 m and superimposed on subsidence area of the Pannonian Basin, formed by fluvial-lacustrine deposits submitted under swamp, subsequently covered with different materials: recent alluvium or wind deposits such as loess (which have grown old farming settlements practicing safer agriculture).

Lowered altitude and low depth of phreatic layer in recent alluvium explained that it not show a continuous arrangement, landscape consisting of a series of levees and river-lake depression areas, characteristic of continental delta (Delta of Mures river).

Depending on the north-south variation of morpho-hydrographic conditions, lithology and nature of agents, it can generally be identified several subunits:

Aranca Plain (Felnac-Periam-Valcani), situated between Mure and Gala ca rivers and it seems like a large depression, is the lowest part of researched area, with 77-83 m altitude, with little depressions and banks with general level bigger with 0,5-1,0 m confronted with general level. Also, there are here and there antropical knolls who are lifting with 3-5 m over general level. Generally, this plain is an low area, with old abandoned flows, with high percent of clay in superficial stratification of soils and extended clayey minerals, place where have been gived an important attention to hydro-improvement works.

Gala ca Plain (Pesac-Lovrin-Teremia) is centred on an old bank of Mure and the main flow of Gala ca river, with 100 m altitude. This plain is form by dense alluvial deposits and sand deposits, in Teremia Mare area the surface is covered by sand hills and it is fixed with vineyards.

Jimbolia-Carpinis-Biled Plain, located between courses of Galatca channel and Beregsau river, has the most fertile soils in the considered area. It is formed mostly from loess deposits in relatively thin layers (2 to 3-4m), superimposed on coarse deposits with fluvial origin.

Cenei-Ionel Plain, is located on the western outskirts of the vast cone of dejection caused the Timis, Bega and Beregs u. With altitudes ranging between 78-89 m, is a relatively recent plain, with an overall plan, divided by numerous meanders and depression areas. Because of diversified micro-relief, the plain surface is strewn with numerous stagnation of water in spring after the snow melting and in the periods of heavy rainfall, which disappear only through evaporation.

S c laz- Becicherecul Mic Plain is represented by a transition field between low and high plains, present in the NE corner of researched area. It takes the form of spurs between Beregsau valleys and its tributaries, with a slight inclination NE - SW.

Although it is bounded in the north by the current course of Mures, the considered space is part of Bega hydrographical basin, Beregs u subbasin, and most importantly rivers courses are Gala ca and Beregs u.

Bega Veche, is the lower course of Bega which, in turn, is a permanent adjustment in the plain of subsidence, of the Timis, Bega and even Mures oldest courses.

Its source became Beregs u, descending from the Lipova Plateau and gathers most rivers from Vinga Plain, including its tributary Magherus with Ludabara and B cin (from the Lipova hills). To these are added a series of erosion valleys which, in the most part of a year are lack of water.

The subsidence of the area caused the groundwater level to rise to near the surface sometimes.

Hydro-ameliorative works were able to descend and to control relative the groundwater levels, giving to agriculture a large part of land affected by excess moisture, favoring the return of soils to their original state after periods of heavy rainfall.

To characterize the specific climatic conditions were used data from Timisoara and SC-DA Lovrin weather stations.

The general characteristic of the thermal regime in the investigated area is due to the dominant influence of the movement of western air masses. Extreme thermic oscillations are attenuated in summer by an improved circulation of air masses from the northwest, and in winter by the south-west air masses.

The yearly average temperature is 10.9 ° C for the period 1887-2011 and 10.6 ° C for 1871 to 1975 (Timisoara station).

From the meteorological station Lovrin, the highest annual average temperature was 12.8 °C in the years 2006/2007, while the lowest annual average was 9.3 °C in the 2004/2005 agricultural year.

Due to cyclone activity and the invasions of moist air from the west, southwest and northwest, in the investigated area the precipitations are quantitatively higher than in other parts of the country, excepting the northwest corner of the plain.

The yearly average of rainfall was 631.0 mm for the period 1871-1975 and 629.9 mm for the period 1987 to 2011 (Timisoara station) and only 500.4 mm in 2010/2001 agricultural year, showing a deviation of -129.5 mm comparing with the normal values.

The investigated area has a great climatic potential: winters are generally short and mild, summers are longer and warmer, earlier springs and autumns with a constant temperature.

As a consequence of the geographic position, relief and his features and alternation of air masses from different directions, the rainfall increases from west to east, but it may be noted that in recent years, in the northwestern part of the plain, just where the soil is most adequate for agriculture (Sânicolau, Teremia, Pesac, Varias), there is a reduction in the amount of rainfall.

This, coupled with reduced groundwater contribution (by lowering the groundwater from hydro-ameliorative works sometimes oversized, has a number of specific issues, specific to aridity process phenomena.

The wind from the south-west of Romania is determined by the development of systems that can interface across Europe to 450 north latitude (anti-cyclones : Azores, Siberian, Scandinavian and cyclones: Mediterranean, Iceland).

The flora and fauna are similar to those of the entire western plains, represented by Crisana and Banat historical provinces, but more xerophite and thermophilic species, with Balkan and Central European ecosystems type.

In this context they highlighted the importance of southern European woody species in vegetation cover building, representative for the area studied, in which species such as: *Quercus cerris*, *Quercus fornitto*, *Quercus pubescens*, *Tillia tomentosa*, *Fraxinus ornus*, *Cornus*

mas is associated, forming biocoenosis with the remarkably accommodating thermophilous grass species (COSTE, 1997).

Following the geographical location, at the interference of low plains and high plains, in the former delta of Mures, the territory presents varied geological and physical-geographical conditions, which conditioned the formation of a complex soil cover.

Thus, in conjunction with the variety of geomorphological factors, geo-lithological, climate or hydrological factors and the various human intervention, have result a varied population of soils with specific characteristics (related or totally different), in permanent evolution.

According with Romanian Taxonomic System of Soils (SRTS 2003) and WRB for SR 1998, in researched area (202920 ha of agricultural land) have been identified detailed units, which are different through their properties, their productive capacity and measures for maintainance and increase their fertility. So, the map of soils include the following types and subtypes of soil:

- Arenosols (mollic, gleyed, sodic), on a surface about 1432 ha, 0,70 %,
- Fluvisols (mollic, gleyed, salic, sodic), on a surface about 17216 ha, 8,48 %,
- Chernozems (gleyed, salic, sodic, vertic), on a surface about 116746 ha, 57,54 %,
- Cambisols (mollic, gleyed, salic, vertic), on a surface about 12340 ha, 6,08 %,
- Pelosols (gleyed), on a surface about 12914 ha, 6,37 %,
- Vertosols (gleyed, salic, sodic), on a surface about 28883 ha, 14,23 %,
- Gleysols (mollic, pelic, sodic, salic), on a surface about 9705 ha, 4,78%
- Solonetz (mollic, gleyed), on a surface about 3684 ha, 1,82%

Each unit of land (TEO) identified were characterized under the current methodology of the soil studies elaboration, using the 23 indicators of evaluation.

These indicators represent the more important characters and features more significant, more precise and measurable, which are usually in pedological mapping works, produced after 1987 by OSPA territorial under methodological guidance of ICPA Bucharest.

Based on the concept methodology became classic in Romania (TEACI, 1980, 1995) and by using a conventional computer language Pascal (adapted from a SPED program, developed by Tarau et al. 2004), were obtained the evaluation notes (1 to 100) for the entire area studied and for each soil type (identified and characterized), for the category of use „Arable” and for the main crops, were established quality (fertility) classes of agricultural land use category of arable land (Table 2).

Class I groups lands without limitations or restrictions, (with notes of evaluation between 81-100 points) represented by cambic chernozem and chernozem (typical, groundwater-wet, weak and moderate gleyed), with medium texture, neutral reaction, occupying 22,63 % of the surface, on about 45906 ha.

On this land is only required the application of appropriate agro-technical measures the range of cultivated plants and landscape features and their strict observance.

Class II groups lands with small limitations or restrictions, (with notes of evaluation between 61-80 points) due to clayey-sandy texture, weak acid and alkaline reaction, periodically moisture excess, occupying 30,85 % of the area, on about 62572 ha.

Require works to prevent and combat periodically moisture excess (rain or groundwater), application of organic fertilizers and green manure at short intervals of 1-2 years, with limestone and dolomite amendment, according to values of agrochemical results.

Class III groups land with medium limitations or restrictions (with notes of evaluation between 41-60 points), represented by soils with moderate and strong acid or alkaline reaction, with periodic stagnant water from rain or affected by groundwater moisture excess, rapid

acidification risk of soil disturbance likely to nitrogen and phosphorus nutrition, the most likely toxic plants, occupying 24,32 % of the area, on about 49443 ha.

Requires amendment with phosphor-gypsum and dolomite in limestone every 5-7 years, organic fertilizer every 3-4 years, fertilization with N, P, K, while keeping an favorable oxidation-reduction environment by improving air-fluid regime with appropriate hydro-ameliorative works (ditches, culverts, drainage, etc.)

Table 2

Fertility classes for arable use category (ha)

No.	Place	Execution year	Agricultural surface	Class I	Class II	Class III	Class IV	Class V	Grade of evaluation
1	Beba Veche	1994	8818	806	2144	2347	2877	644	50
2	Biled	1997	9344	4750	3216	695	365	318	76
3	Becicherec	1982	9845	2588	2772	1788	1428	1269	68
4	C rpini	1996	7399	4127	2391	275	235	371	77
5	Cenad	1994	7383	590	2867	770	2602	554	52
6	Cenei +Checea	1994	11644	1078	3891	3075	3246	354	54
7	Comlo u M.	1996	8724	3381	2529	1352	1118	344	71
8	Dude tii V.	1994	19062	634	2066	6946	8295	1121	46
9	Jimbolia	1996	9745	2497	3990	2274	794	240	67
10	Lenauheim	1996	10520	5571	2079	1713	582	575	72
11	Lovrin	1996	11719	5309	4841	319	948	302	76
12	Periam	1995	9043	3535	3088	1959	397	64	74
13	Sănnicolau M	1995	12689	680	3990	5996	1642	451	59
14	Sămpertu M.	1995	18796	3188	4778	6770	2590	1470	59
15	Sănmihaiu R	1999	6851	192	1603	1698	2930	428	46
16	S c laz	2009	10827	562	4180	3284	1356	245	48
17	Timi oara	2002	7833	850	2488	3686	844	265	55
18	Teremia M.	1994	7749	240	4168	1399	1461	481	60
19	Varia	1983	10366	5255	2732	1452	352	575	74
20	Felnac	2003	665	-	342	251	30	36	57
21	Secusigiu	1974	3898	73	2231	694	160	140	63
	General total		202920	45906	62572	49443	34752	10247	62

Class IV, groups lands with large limitations and restrictions, (with notes of evaluation between 21-40 points) and include hydromorphic soils with unfavorable physical, hydro and physico-chemical properties, occupying 17,13 % of the area, on about 34752 ha.

For use as arable land is necessary to apply a complex characteristic ameliorative measures: drainage, gypsum amendment, specific agricultural technique, choice of appropriate plants (sorghum, barley, alfalfa, lupine, etc.).

Class V, groups lands with severe limitations and restrictions, (with notes of evaluation between 1-20 points) which includes land affected by excess moisture or stagnant groundwater, occupying 5,07 % of the area, on about 10247 ha.

Due to higher restrictions faced by these areas, will remain natural grasslands or in the perspective for superior recovery facilities will be transformed by fishing ponds, rice plantation etc.

CONCLUSIONS

Knowledge of the productive capacity of land is a laborious process of thought, forming working hypotheses and modeling in all aspects, logical, mathematical, heuristic, etc.. validation and verification procedures by multiple (chemical, physical, economic, etc.), for the most appropriate means of expressing the concepts in all their complexity, the resulting coexistence of the natural biocenosis and biotope.

Using electronic computer was therefore a need to servants in good trends (fully justified) continuous improvement methodology for assessing the production of land, which led to the design and implementation of conditional evaluation system for agricultural land.

Pedological information so processed may play an important role in introducing cadastral records with technical, economic and legal attributes, making the identification, description and representation of all cadastral maps and plans indicating lands, how to use, natural and ecological capacity etc. of the anthropogenically induced ones.

Appropriate data files of administrative cadastral territory and soils map, including soil studies related cartograms made after 1987 is the first database, and when a territory has a specific database graphic and alpha numeric Geographic Information System (GIS) information referred to can be transferred in this system.

The pedological information at the local administrative level can provide to decision maker tactical information to establish the technical and economic measures necessary to ensure the short or medium term consistency of the economic and social development of a given territory and protect the quality of the environment in general.

Pedological information from data banks so formed can be used to make of synthesis planning zonal land works according to their vocation for certain categories of use or their suitability for specific crop.

BIBLIOGRAPHY

1. BORZA I, R U D, R U I, 2001, Soils degradation process and restoring measures in south-west Romania, Ed. Oriz. Univ. Timi oara, pag. 195.
2. COSTE I, R U D, ROGOBETE GH, 1997, Trends in the development of the environment in South-West of Romania, Na ional Symposion of pedology Timi oara, pag. 7-25.
3. DUMITRU M, 2000, Monitoring status of soil quality in Romania, Ed. GNP Bucharest, pag. 23-90.
4. FLOREA N, B L CEANU V, CANARACHE A, 1987, Methodology of soil studies development, vol. I, II, III, ICPA Bucharest, pag. 10-15 (I), 30-71 (II), 29-100 (III).
5. FLOREA N, MUNTEANU I, 2003, Romanian System of Soil Taxonomy, Ed. Estfalia, Bucharest, pag. 35-54.
6. IANO GH, ROGOBETE GH, PU C I, BORZA I, R U D, 1994, Evolution of the Banat plain from submerged to current state phase, Soil Science. nr. 28C, Bucharest
7. TEACI D, 1980, Evaluation of agricultural land, Ed. Ceres, Bucharest, pag. 15-200.
8. TEACI D, 1995, Romanian agriculture and forestry - 2020. Integration into European and world, Ed. Omnipres Bucharest
9. R U D, BORZA I, 2002, Assessment of the conditions of natural and anthropogenic induced production capacity in terms of defining land in western Romania, Soil Science nr. 2, vol. XXXVI, pag. 148-160
10. R U D, MARTON GH, RACOVICAN M, TRETA D, 2004, The impact of information technology on mapping activities, updating and modernizing the soil studies, Soil Science, vol. XXXIV, nr. 1-2, p.188-199