SOIL FUND STRUCTURE AND SOIL QUALITY IN THE MIDDLE AND LOWER COURSE OF THE RIVER TIMIŞ, ROMANIA

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Abstract *The purpose of the researches is rooted in the current scientific and practical discussions on the accumulation of knowledge regarding the physical, chemical and microbiological characteristics of the soils in relation to the natural features of the natural framework for the evaluation of their quality, which are found in the pedological studies prepared by the local OSPA. The relief on which the river basin of the river Timis is grafted is varied – mountains, hills and plains – so that the territory taken into account determines a great diversity of ecological conditions, generated by the variability of cosmic-atmospheric and earthly-edaphic factors that compete at achieving the environment in which plants grow and harvest. The issue addressed concerns an area of 328,728 ha of which 271,037 ha (82.45%) are agricultural land. The importance and timeliness of the work is the need to protect the edaphic cover and the environment by the accumulation of scientific data necessary for the substantiation of some technologies of consecutive works of edaphic cover and of sustainable management of the soil and water resources; and by implementation of conservative and sustainable management systems in the physical-geographical and climatic-edaphic conditions within the space considered.*

Keywords: *land, soil, quality, risk*

INTRODUCTION

The earthly-edaphic resources represented by relief, soil, water, vegetation and fauna have a number of properties defined and studied over time (BORZA *ET AL*., 2005; CANARACHE *ET AL*., 1980; COSTE *ET AL*., 1997; DUMITRU AND COLL., 2000; NIȚĂ *ET AL*., 2010; RĂUȚĂ, 1997; TEACI, 1980, 1983; ȚARĂU *ET AL*., 2015), which served and serve both for specifying the genetic and parametric clarification entities of the soil and land units for the definition of agricultural practices whose technological solutions can ensure efficient agronomic, ecological and conservative management of the soil and the environment.

This inter-conditioning has been underlined in recent years by a number of international bodies (FAO, UNESCO, etc.) and unanimously accepted and appropriated by all participating countries (including Romania) at the Rio United Nations Environment and Development Conference in Rio de Janeiro (1992), Johannesburg (2002).

Agenda 2030 for Sustainable Development, adopted by the United Nations on 25 September 2015, sets a global framework for poverty eradication and sustainable development by 2030, based on the Millennium Development Goals (MDGs) adopted in 2000.

Considering all these, in the paper are presented, on the basis of the pedological information existing in the OSPA archive in Timisoara, most on classical support, as well as on the basis of the $SPED_1$ information system and the BDUST-B system implemented in the territory by ICPA Bucharest (OSPA, USAMVB and UP of Timisoara), some aspects related to the pedoclimatic characteristics as elements that define the fertility and the quality of soils in order to ensure the field users the specialized support for the elaboration sustainable management programs.

MATERIAL AND METHODS

The issue concerns a surface area of 328,728 ha (Table 1) of which 271,037 ha are agricultural land (82.45%) situated in the middle and lower basin of the Timiş River, which, from an administrative point of view, belong to a number of 35 territorial administrative units (ATU) from Timis County.

Table 1

Situation of the land fund in the middle and lower course of the river Timiş

Crt. No.	Locality	Arable	Grasslands	Haymaking fields	Vineyards	Orchards	Total agricultural land	Forests	Waters	Other categories	General total lands
1	Bârna	1792	1568	513	2	60	3935	3750	11	166	7862
2	Criciova	1484	1053	259	0	225	3021	1686	140	204	5051
3	Darova	7343	1283	602	0	144	9372	629	76	382	10459
4	Găvojdia	4368	1783	232	0	71	6454	316	220	504	7494
5	Lugoj	2802	2265	142	287	110	5606	2417	410	1418	9851
6	Nădrag	231	262	129	0	1	623	12291	16	321	13251
7	Ştiuca	4490	3512	554	1	218	8775	1299	35	247	10356
	C M	***22510***	***11726***	***2431***	***290***	***829***	***37786***	***22388***	***908***	***3242***	***64324***
8	Banloc-Livezile	12442	2816	214	0	9	15481	572	543	764	17360
9	Belinţ	4518	1104	45	0	44	5711	59	142	408	6320
10	Boldur	5604	861	187	1	5	6658	1336	111	383	8488
11	Buziaş	5373	1429	308	849	41	8000	1705	41	848	10594
12	Ciacova	10221	1964	263	0	58	12506	299	352	692	13849
13	Chevereşu Mar	4804	1043	573	0	5	6425	1101	241	350	8117
14	Coşteiu	4825	1798	191	1	25	6840	993	155	375	8363
15	Cenei -Checea	10178	1304	154	1	7	11644	14	227	646	12531
16	Foeni	4728	931	151	0	6	5816	3	194	393	6406
17	Ghilad	8223	2076	162	1	25	10487	41	352	547	11427
18	Giera	6446	2002	101	0	7	8556	6	278	335	9175
19	Giulvăz	7082	2143	317	4	2	9548	11	268	469	10296
20	Jebel-Pădureni	8045	1634	258	0	5	9942	1260	319	553	12074
21	Liebling	6498	858	406	0	12	7774	21	124	307	8226
22	Moşniţa Nouă	4783	761	87	0	0	5631	250	245	511	6637
23	Nitchidorf	4105	820	193	2	254	5374	694	71	274	6413
24	Racoviţa	7235	1666	225	1	5	9132	1870	244	472	11718
25	Peciu Nou	9118	1960	883	24	210	12195	54	206	519	12974
26	Sacoşu Turcesc	9201	1509	238	4	115	11067	381	452	553	12453
27	Sânmihaiu Român	5344	1137	362	4	4	6851	10	225	440	7526
28	Şag-Parţa	7217	1130	100	55	24	8526	76	255	682	9539
29	Tormac	10917	1382	448	1	5	12753	100	92	463	13408
30	V.V. Delamarina	6950	2045	812	1	1904	11712	1721	58	504	13995
31	Voiteg	5438	932	151	0	2	6523	11	101	327	6962
32	Uivar	15658	2213	214	1	13	18099	24	594	836	19553
		184953	**37518**	**7043**	**950**	**2787**	**233251**	**12612**	**5890**	**12651**	**264404**
	Total ha	**207463**	**49244**	**9474**	**1240**	**3616**	**271037**	**35000**	**6798**	**15893**	**328728**

The research of the eco-pedological conditions was done in accordance with the Methodology of the Pedological Education Elaboration (vol. I, II, III) elaborated by ICPA Bucharest in 1987, supplemented with specific elements of the Romanian Soil Taxonomy System (SRTS-2012), as well as other normative acts updated by MAAP Order 223/2002, respectively Order MADR 278/2011, based on the pedological information accumulated in the OSPA archive in Timişoara (for more than 65 years), but also on the basis of the research

carried out by the authors in time (OSPA, USAMVB and UP from Timisoara), studies completed with elements recently collected from the field.

RESULTS AND DICUSSIONS

The object of study is the area of 330,270 ha (Table 1), out of which 269,261 ha are agricultural lands (81.53%), located in the middle and lower basin of the Timiș River, namely identified soil and ground units (TEO) in the respective perimeter and their quality status.

Timis River, the most important hydrographic artery in Banat, collects the waters from a 5,248.0 km2 river basin with a 241.2 km long track.

After coming out from the Semenic Peak (at 1446 m), it is captured in the accumulation of "3 Waters", followed by a short route with the west-east orientation, to Teregova, where it changes its direction south-north, becomes the collector of a major number of rivers draining the Semenic, Tarcu, Godeanu and Poiana Rusca Mountains, among which the Hideg River and the Bistra River.

The middle course crosses, alongside Bega, the depression area of Lugoj, receiving numerous smaller tributaries of the Poiana Rusca Mountains, Surduc Hills and Buziasului Hills (Pogănișului), of which the Nădrag Creek and Știuca, Spaia, Sălbăgel and Vâna Mare streams, which collects the waters of erosion valleys and torrential elements in the hilly and pre-hilly area, to which are added a series of much smaller valleys, but with constant flows, fed from the rich underground waters accumulated in sedimentary formations.

The lower course of Timis starts from the village of Coștei, from where it forms a large valley, with many meanders, divagations and ponds, phenomena favoured by the very low slope and the depth of waterproof clay deposits. The great hydrotechnical works, started in the 18th century, created the drainage and navigation system Bega - Timis through sewerage, regularization, and ditching of the courses of the two rivers, have brought down their lower basins under their floods.

Among the tributaries received by Timis in its lower basin, the most important is Poganisul. It collects the waters of the hills of the same name, constituting a collection basin of 700 km^2 and a length of nearly 100 km.

The drainage regime, with strong floods that produced many floods, caused regularization and dyke of the bed.

The relief on which the river basin of the river Timis is grafted is very varied: mountains, hills and plains, where petrographic facies vary from one area to another. At the same time, the investigated space has a pronounced climatic, pedological and geobotanic nuance, the components of the natural framework, with their particularities, to which is added (direct or indirect) the activity of man, influences all processes and hydrological and pedo-genetic phenomena carried out over time.

The living expression of the pedo-hydro-climatic and floristic conditions as well as the human intervention, beginning with the rise of the first mounds or waves of earth and continuing with the hydroelectric works executed about 250 years ago, the soils in the investigated space present a great diversity. According to the Romanian Soil Taxonomy System (SRTS-2012), they identified 17 types and associations of soils (Litosols, Regosols, Aluviosols, Chernozems, Faeosomes, Eutricambosols, Districambosols, Preluvosols, Luvosols, Planosols, Verosols, Pelosols, Stagnosols, Antisols, Technosols) comprising 11 of the 12 soil classes (Protisols, Chernisols, Umbrisols, Cambisols, Luvisols, Spodisols, Vertisols, Hydrisols, Salsodisols, Histisols, Antrisols).

In this context, the quality of agricultural lands as a result of the diversity of physical-geographic conditions and their intrinsic properties, as well as of anthropogenic interventions in time, it is very different in space, which is why the Romanian methodology of land consolidation which includes the synthesis of knowledge (Teaci, 1980; ICPA Bucharest, 1987) defines the land in ecological terms in relation to the cosmic-atmospheric and earthly-edaphic factors.

The basic principle of the credit assessment methodology developed in our country is that for each unit of homogeneous ecological territory (TEO) within a territorial administrative unit (ATU) defined according to the current Methodology for Development of Pedological Studies using the 23 indicators which are usually

found in the pedological mapping works developed after 1987 by the territorial OSPA under the methodological guidance of ICPA Bucharest, the quality is established by credit scores from 1 to 100.

Each of the units identified within the investigated area was characterized according to the Methodology of Elaboration of Pedological Studies (MESP 1987, vol. I, II, III) using the 23 qualifying indicators representing more important, more significant, and more easily measurable features, which are usually found in soil studies and research (developed by local OSPA), namely: climatic indicators (3C indicator – annual average temperature – corrected values, 4C indicator – annual average precipitation – corrected values), indicators of some morphological, chemical, physical, hydro-physical characteristics and volume of soil cover (indicator 14 – gleaning, indicator 15 – stagnogenisation, indicator 16 or 17 – salinisation or alkalization, (indicator 61 – total $CaCO_3$ content on 0-50 cm, indicator 63 – soil response in Ap or in the first 20 cm, indicator 144 – reserve the humus in the 0-50 cm layer, the 23A indicator – the texture in the Ap or the first 20 cm, the indicator 44 – the total porosity in the restrictive horizon, the indicator 44 – the total porosity in the restrictive horizon, the indicator 133 – the useful edaphic volume), relief (indicator 33 – slope, indicator 38 – slides), indicators referring to hydrography, hydrology and drainage of the territory (indicator 40 – flood indicators, indicator 181 – stagnant humidity excess, indicator 39 – groundwater depth), indicators for some anthropogenic events (indicator 29 – pollution, indicator 271 – land improvement improvements) and interactions between these attributes characterization values of natural and anthropically induced features.

On land grading for natural conditions, each of the above indicators is involved in establishing the credit score by a rating coefficient varying between 0 and 1 as the appropriation is totally unfavourable or optimal for the requirements of the use or plant considered (Appendices 3-1 to 3-18, MESP, 1987, Vol. II).

Thus, on the basis of pedological information processed according to the Methodology for the Development of Pedological Studies (ICPA Bucureşti, 1987) and other normative acts updated by Order MADR 278 / 2011, the agricultural lands of the researched space can be grouped (from 20 to 20 points) in five classes (quality) according to their vocation for arable use (Table 2)

Table 2.

Suitability classes (quality) for category of use "ARABIL" (ha)

Territorial Administrative Unit (TAU)	Year of execution	Arable	1st class (81-100 pts.)	2nd class (61-80 pts.)	3rd class (41-60 pts.)	4th class (21-40 pts.)	5th class (0-20 pts.)	Weighted mean score
Bârna	1992	1792	0	0	533	696	563	40
Criciova	1991	1484	0	166	384	483	451	38
Darova	1989	7343	0	506	3859	2848	130	41
Găvojdia	1991	4368	0	1064	1213	1734	357	42
Lugoj	1987	2802	87	883	866	750	216	48
Nădrag	1992	231	0	0	35	97	99	21
Ştiuca	1989	4490	0	852	1104	1999	535	42
Banloc+Livezile	1988	12442	201	4371	3201	3607	1062	50
Belinț	1987	4518	152	1282	1120	1270	694	48
Boldur	1987	5604	185	2914	1882	378	245	58
Buziaş	1984	5373	0	1107	2704	1404	158	49
Ciacova	1985	10221	121	2700	4300	2300	800	54
Chevereşu Mare	2003	4804	0	1448	2972	370	14	57
Coşteiu	1987	4825	82	636	1035	1367	1705	36
Cenei -Checea	1994	10178	1074	2927	2845	3037	295	54
Foeni	2007	4728	720	1610	1145	1121	132	57
Ghilad	1985	8223	466	2389	2882	1944	542	54
Giera	1988	6446	570	1955	1848	1682	391	50
Giulvăz	2008	7082	68	1859	2707	1943	505	50
Jebel-Pădureni	2011	8045	465	4178	2532	684	186	59
Liebling	1982	6498	722	1216	2215	1719	626	55
Moşniţa Nouă	1997	4783	146	2250	2075	259	53	58

Nițchidorf	1980	4105	0	532	2706	535	332	49
Racovița	1986	7235	774	1302	3792	1260	107	55
Peciu Nou	2011	9118	425	4998	2668	440	587	60
Sacoșu Turcesc	2009	9201	174	3748	3528	1674	77	57
Sânmihaiu Româi	1999	5344	192	1373	1159	2414	206	46
Șag-Parța	2010	7217	136	3308	2742	924	107	57
Tormac	1983	10917	0	501	6232	4008	176	42
V.V. Delamarina	2000	6950	0	335	2311	4056	248	38
Voiteni	1992	5438	1124	2893	951	328	142	75
Uivar	2010	15658	1645	4162	7051	2623	177	57
Total		**207463**	**9529**	**59465**	**76597**	**49954**	**11918**	

According to the data obtained, a surface of 13,733 ha of the ARABLE lands (located at TAU Liebling and Racovita) has a weighted average rating (55 points) for the mentioned use category equal to the weighted average score obtained at Timis County, a production potential at the level of the county's average production.

Below the level of the average potential there are arable lands located within the TAU radius: Bărna, Criciova, Darova, Găvojdia, Lugoj, Nădrag Știuca (mountainous and pre-mountainous), Banloc-Livezile, Belinț, Boldur, Buziaș, Ciacova, Coșteiu, Cenei-Checea, Ghilad, Giera, Giulvaz, Nitzchidorf, Sânmihaiu Roman, Tormac, and V. V. Delamarina.

Table 3.

Situation of land affected by excess surface and ground moisture

Nr. crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			Surface moisture excess			Ground moisture excess		
			low	moderate	excessive	moderate	strong	excessive
1	Bârna	3934	30	293	0	10	0	0
2	Criciova	3022	330	811	49	218	89	359
3	Darova	9328	3070	3121	1155	607	323	34
4	Găvojdia	6454	693	909	2391	489	219	292
5	Lugoj	5634	1607	1790	468	1904	661	467
6	Nădrag	623	52	11	0	11	9	16
7	Știuca	8694	2990	3678	833	0	547	40
8	Banloc -Livezile	15481	1294	4435	1338	6801	2814	158
9	Belinț	5711	3317	1040	997	3675	1069	611
10	Boldur	6722	1600	42	33	3356	463	169
11	Buziaș	8006	2155	3105	1212	335	341	30
12	Ciacova- Ghilad(13)	23119	9307	1941	0	5409	3958	8096
14	Cenei - Checea	11491	1467	901	6745	2231	6498	14
15	Chevereșu Mare	6199	1766	3574	59	1169	73	879
16	Coșteiu	6817	609	1102	2171	649	1533	212
17	Foeni	5799	0	0	12	2993	966	552
18	Giera	8570	36	161	5882	3302	5159	0
19	Giulvăz	9359	0	0	0	4256	282	0
20	Jebel (+Pădureni)	9584	160	77	0	2671	1509	0
21	Liebling	8334	2468	3203	1171	1757	540	1404
22	Moșnița Nouă	5635	167	115	0	0	0	0
23	Nițchidorf	5445	902	1614	1780	1239	0	307
24	Peciu Nou	11629	0	0	0	8119	2605	418
25	Racovița	9116	2754	1524	611	2875	2400	876
26	Sacoșu Turcesc	10483	1062	1979	2158	5525	3173	718

Nr. crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			Surface moisture excess			Ground moisture excess		
			low	moderate	excessive	moderate	strong	excessive
1	Bârna	3934	30	293	0	10	0	0
27	Sânmihaiu Român	6852	0	0	0	644	668	0
28	Şag -Parţa	8383	33	2070	695	2138	741	10
29	Tormac	12714	1026	3111	8482	117	392	249
30	Uivar	17419	2508	3414	2068	6029	1885	1606
31	V .V.Delamarina	11377	546	2665	72	456	470	373
32	Voiteg	7424	3440	0	0	559	2732	298
TOTAL		269358	45389	46686	40382	69544	42119	18188

From the enumeration of the main physico-geographic and edaphic characteristics of the lands within the researched space and from the analysis of the limiting factors (tab.3,4), resulting in their classification in quality classes, there is a need for interventions with pedo-hydraulic or cultural measures required by the case to the case:

• Measures to correct the acid reaction by periodic or alkaline calcination by gypsum;

• Improving plant nutrition conditions through ameliorative fertilization;

• Providing an optimal aerodynamic regime through works to prevent and combat excess moisture (channels, ditches, drains, drains, etc.) or, as the case may be, aridisation tendencies (irrigation, protection curtains, appropriate cultures);

• Prevention and control of landslides and soil erosion (earth waves, coastal canals, furrows, anti-erosion curtains);

• Application of soil cultivation technologies to avoid their destruction and the formation of hardwood;

• Increasing the protection of areas by organizing buffer zones around them, but especially by organizing some improvement areas, revising and modernizing the existing ones;

• Protection of biodiversity by introducing agro-environmental schemes experienced in pilot farms with regard to the application of an agricultural management appropriate to the specific eco-pedological conditions of a particular place at a certain moment, etc.

Table 4.

Situation of plots affected by salinity, acidification

Nr. Crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			salinisation			salinisation		
			low	moderate	excessive	low	moderate	excessive
1	Bârna	3934	0	0	0	429	489	12
2	Criciova	3022	0	0	0	826	1438	424
3	Darova	9328	0	0	0	3139	6797	0
4	Găvojdia	6454	0	0	0	2616	2543	29
5	Lugoj	5634	0	0	0	3053	1803	199
6	Nădrag	623	0	0	0	208	311	0
7	Ştiuca	8694	0	0	0	4437	3181	40
8	Banloc (Livezile)	15481	5605	370	132	6337	1832	0
9	Belinţ	5711	0	0	0	1185	3805	365
10	Boldur	6722	0	0	0	2449	2886	0
11	Buziaş	8006	0	0	0	3999	4136	0

Nr. Crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			salinisation			salinisation		
			low	moderate	excessive	low	moderate	excessive
12	Ciacova -Ghilad	23119	12597	238	1306	12596	3806	0
14	Cenei -Checea	11491	4605	277	430	5640	147	0
15	Chevereșu Mare	6199	868	223	0	4611	1056	0
16	Coşteiu	6817	0	0	0	844	3778	1153
17	Foeni	5799	2160	175	233	905	700	379
18	Giera	8570	1808	139	1832	4479	482	0
19	Giulvăz	9359	6438	135	2844	2402	37	0
20	Jebel (+Pădureni)	9584	1274	1351	655	6555	848	0
21	Liebling	8334	1135	0	351	5335	360	0
22	Moşniţa Nouă	5635	23	598	13	1708	3710	0
23	Nitchidorf	5445	34	0	0	2429	2988	0
24	Peciu Nou	11629	2223	586	1993	3663	1922	0
25	Racoviţa	9116	0	0	0	1173	2526	37
26	SacoşuTurcesc	10483	332	122	311	5958	2930	0
27	Sânmihaiu Roman	6852	2375	1246	1263	4680	326	0
28	Şag (+Parţa)	8383	417	226	377	3790	2596	0
29	Tormac	12714	0	0	0	6776	5116	158
30	Uivar	17419	7582	284	784	3484	399	0
31	V.V.Delamarina	11377	0	0	0	4545	5902	0
73	Voiteni	7424	211	98	53	3836	1506	0
TOTAL		**265424**	**49687**	**6068**	**12577**	**113658**	**69867**	**2784**

CONCLUSIONS

Knowing the natural conditions and especially the ecological potential of the lands (defined according to MESP-ICPA Bucharest, 1987) for the main categories of use and crops is of particular importance in carrying out the qualitative assessment of the land, which justifies the necessity and the actuality of the pedological mapping activity and periodic agro-chemistry.

The systematic soil and soil agrochemical surveys carried out by the Pedological and Agrochemical Offices of our country provide valuable data on the evolution of soil quality, the differentiation and establishment of crop technologies, land retention and the establishment of favourability for different cultures, substantiating land improvement and improvement technologies, organizing and systematizing the territory. Also, the topicality of the chartering, landmarking and land valuation activity also derives from the fact that the land, besides its historical-natural features, is the most important means of production in agriculture and forestry, and an asset that is subject to property and, implicitly, an object of market exchange, having a certain value for use.

From the presented data, it follows that, under the conditions of a seemingly good natural ecological potential, the general situation of the natural resources and the anthropic induced ones is unsatisfactory as most of them are affected by the existence of one or more limiting and restrictive factors which are sufficient motivations to justify the need to develop short-term and medium-term strategies for the protection and conservation of earthly-edaphic factors and the need to respect the frequency of field and laboratory investigations at all points in the 8x8 km grid of the National Soil-Land Monitoring System (ICPA) and completing it with pedological and agrochemical studies.

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