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PHYSICAL-GEOGRAPHICAL AND SOCIO-ECONOMIC CONDITIONS DEFINING THE QUALITY OF THE ECO-PEDOLOGICAL RESOURCES IN THE TIMIŞOARA METROPOLITAN AREA

Lucian Dumitru NIȚĂ[1], Dorin ȚĂRĂU[1], Gheorghe ROGOBETE[2], Florin CRISTA[1], Simona NIȚĂ[1], Karel Iaroslav LAȚO[1], Anișoara DUMA COPCEA[1], Alina LAȚO[1], Adalbert OKROS[1]

[1]University of Life Sciences "King Michael I" from Timisoara,
119 Calea Aradului Street, Timisoara, Timis County, Romania
[2]University "Polytechnic" of Timisoara, 2 Piața Victoriei Street, Timisoara, Timis County, Romania

Corresponding author email: simona_nita@usvt.ro

Abstract

The ecopedological resources together with the physical-geographical factors and the regime of climatic factors constitute a subsystem called biotope or resort which is in close connection with the associations of plants and animals, together making up terrestrial ecosystems, they having the ability to transform the energy they store in biomass, between these and socio-economic interventions, relations of a varied and complex reciprocity can be established.The Timişoara metropolitan area, from this paper, is a project that includes the municipality of Timişoara, the city of Recaş and 25 other neighboring territorial administrative units in order to create an integrated administrative unit between the municipality of Timişoara and the neighboring localities, which would include 468,162 of inhabitants, on an area of 223952 ha, establishing relations of economic, social and cultural cooperation, territorial development, technical-building equipment and environmental protection, each locality maintaining its autonomy. In Romania, metropolitan areas were regulated by law 351 of July 6, 2001 an area constituted by association, based on voluntary partnership, between large urban centers and urban and rural localities located at distances of up to 30 km.

Key words*: quality, eco-pedological, metropolitan, resources, sustainable.*

INTRODUCTION

The intervention of the human, begun with the elevation of the first mounds and waves of land, then continued with the hydro-meliorative works (initiated about 250 years ago) and with the intensification of social-economic activities, especially in the second half of the 20th century, also had, besides beneficial effects generated by economic increases, negative effects affecting, increasingly, the edaphic cover. Although the idea that soils are one of the most important components of the environment is unanimously accepted, the information provided by soil science is often underestimated or even ignored. The environment represented by water, air, soil, vegetation, and fauna is a set of spatial-temporal formations that function as cyber systems, with permanent exchanges of substances, energy and information, both between the phyto-coenotic and zoo-coenotic elements and with the environment, having the ability to transform cosmic energy into potential energy that they store in vegetable and animal biomass. In this context, the major directions of the Romanian Soil Science School (Florea et al., 1995; 2012; Ianoş et al., 1994; Niţă et al., 2018; 2019; Rogobete et al., 1997; Ţărău et al., 2006; 2007; 2019; Uruioc et al., 1993) regarding the assurance of a unitary land research framework corresponding to the requirements of sustainable agriculture and environmental protection will have to solve, in order to connect to the European system, in full agreement and harmony, the following functions specific to the respective land: ecological, economic, technical, social, and legal. In view of these considerations, the authors of this paper try to present some aspects regarding the use of pedological information from pedological studies and stored in the O.S.P.A. Timişoara for the most part on classic support, but also on the basis of the Speed 1 computer system (used at O.S.P.A. Timișoara in 1988) and the BDUST-implemented system by I.C.P.A. Bucharest, since 2002, but also in the

databases of research programs carried out over time by the authors (within the O.S.P.A., U.S.A.M.V.B. and U.P.T. in Timişoara, for the qualitative evaluation of the eco-pedological resources in the Timişoara Metropolitan Area and of possible pressures on them, but also of measures to promote some environmental social practice.

MATERIALS AND METHODS

The issue addressed refers to an area of 223952 ha in the area of Timişoara Municipality, the town of Recaş and 25 other neighbouring territorial administrative units (TAU) (Table 1).The starting data of the project of the Timişoara Metropolitan Area have existed since 2000 when, within a large private public partnership, the ***Strategic concept of economic and social development of the Timisoara Area***, which includes objectives and measures for both Timisoara and six communes on the first ring of development of the city: Dumbrăviţa, Ghiroda, Giroc, Moşniţa Nouă, Săcălaz, and Sânmihaiu Român. This strategic concept was approved by the Timisoara Local Council and by all important political forces, and the Timiş County Council participated in the elaboration ensuring even the methodological consultant.

Table 1. Structure of the land fund for the main categories of use*

Nr.	UAT	nr. inhabitans**	Arable	Grasslands	Haymaking fields	Vineyards	Orchards	Agricultural	Forests	Waters	Other	Total
1	Timişoara[1]	331927	4088	155	84	8	6	4341	730	317	7539	12927
2	Becicherecu Mic	3158	3545	418	251	0	3	4217	0	0	448	4665
3	Biled	4062	4467	463	12	3	1	4946	0	173	392	5511
4	Bucovăţ	1804	2358	404	63	1	0	2826	208	44	174	3252
5	Chevereşu Mare	2272	4371	1040	571	1	5	5988	1092	241	796	8117
6	Dudeştii Noi	3341	3515	1013	248	0	0	4776	45	296	276	5393
7	Dumbrăviţa [2]	8935	543	50	1	1	1	596	1	46	1255	1898
8	Ghiroda[3]	6802	2241	338	218	3	12	2812	5	125	471	3413
9	Giarmata	7261	5977	54	148	60	292	6531	16	86	517	7150
10	Giroc [4]	11753	3580	291	32	0	0	3903	419	128	827	5277
11	Jebel	3614	5315	753	155	0	2	6225	17	148	353	6743
12	Liebling	4160	6671	658	443	0	2	7774	21	99	332	8226
13	Maşloc	2489	5175	1120	507	0	163	6965	983	27	316	8291
14	Mosnita Noua[5]	7890	4097	548	20	0	0	4665	174	0	2049	6888
15	Orţişoara	4600	11610	1558	524	2	74	13768	57	112	626	14563
16	Parţa	2372	4845	672	42	1	0	5560	35	181	361	6137
17	Pădureni	1749	2753	881	103	0	3	3740	1243	171	177	5331
18	Peciu Nou	5570	9113	1959	882	24	210	12188	54	206	526	12974
19	Pişchia	3148	7203	1206	513	285	489	9696	1963	188	514	12361
20	Recaş	9584	12121	4736	982	1589	230	19658	1810	403	1117	22988
21	Remetea Mare	2603	4815	903	163	61	14	5956	586	199	548	7289
22	Sacoşu Turcesc	3205	9202	1509	238	4	115	11068	381	452	552	12453
23	Satchinez	5026	8027	575	314	2	7	8925	10	482	571	9988
24	Săcălaz [6]	8807	9438	1174	0	4	6	10622	0	358	969	11949
25	Sânandrei	6902	6986	1002	233	1	5	8227	23	171	819	9240
26	Sânmihaiu Român [7]	7272	5335	1137	362	3	4	6841	10	225	450	7526
27	Şag	3437	2467	216	28	30	10	2751	42	75	534	3402
	Total	468162	149858	24833	7137	2083	1654	185565	9925	4953	23509	223952
	%		80.76	13.38	3.84	1.12	0.90	82.86	4.42	2.22	10.5	100

*Institutul Naţional de Statistică Bucureşti, 2014
**Institutul Naţional de Statistică Bucureşti, 2016 (Populaţia României după domiciliu)

The **municipality of Timişoara**, located at the intersection of the parallel of 45°47' North latitude, with the meridian of 21°17" Eastern longitude, being in the northern hemisphere, at almost equal distances from the North Pole and the Equator and in the Eastern Hemisphere, in the time zone of Central Europe, through its geographical position, the transport infrastructure, and the utility network is the engine of development in the intra-regional development plan. The naturalistic characterization of the studied area, the interpretation and processing of the entire volume of information (land, laboratory, office) were made in accordance with the methodology of elaborating pedological studies (M.E.S.P.) elaborated by I.C.P.A. Bucharest, in 1987, supplemented with elements (related to soil taxonomy) in the Romanian soil taxonomy system (SRTS-2003, respectively SRTS-2012). The analyses were performed in the U.S.A.M.V.B. Timişoara and O.S.P.A. Timişoara, according to national

norms and standards, approved by the Standardization Association in Romania (A.S.ro.), and, since 2009, in the Laboratory of Physical-Chemical Analysis - O.S.P.A. U.S.A.M.V.B.T., Faculty of Agriculture, Banat University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania" from Timișoara, Calea Aradului, no. 119, accredited RENAR according to STAS SR EN ISO/CEI 17025, by the accreditation certificate no. LI 1001/2013.

RESULTS AND DISCUSSIONS

From a geomorphological point of view, the researched perimeter is part of the great physical-geographical unit called the Banato-Crișană Plain, the subunit of the Timiș-Bega interfluve plain to the north of the Vinga Plain and the Tormac-Gătaia Plain. The Vinga Plain, the oldest and most complex in geographical aspect (Posea, 1997), is located south of Mureș, west of Lipovei Plateau, north of the subsident Bega-Timiș area, west of the Giucoșin-Aranca subsident area formed by the divergence of the glacis intensely modelled by a secondary network of current waters and valleys at an altitude of 95-200 m compared to the reference level. Part of the Southern Mureș Plain (Mihăilă et al., 1990,) has the appearance of a Piedmont plateau in steps, clearly detached under the altimetric, geomorphological, and structural report from the northern Mureș and the Lipovei Hills in the east. The Vinga Plain has four altitudinal steps arranged in a fan-matrix made by Mureș River, and of local tectonic influence, respectively by the hidden laccolite Luda-Bara, which produced a vault, in the east, a radial circular, asymmetric hydrography and a similar fragmentation of the plain, thus forming, towards the Lipovei Plateau, two interfluvial elongated fields towards south-west and other fields almost radially circular to south-west (Posea, 1997). Bizerea (1973) considers these steps more tectonic, distinguishing five levels: Seceani (180 m), Alioș (160 m), Vinga (150 m), Calacea (130 m), and Satchinez (100 m). Developing south of Mureș, between Lipova and Secusigiu (Satu Mare), the northern limit is given by Lunca Mureșului, also imposed by a subsident area. The eastern limit to Lipovei Plateau is marked by a level of 40-60 m, between Lipova and Mașloc, the limit altitude oscillating between 180-190 m (under the patches of terrace 5, which remain in the plateau at 200-220 m – Posea, 1997), and then by Beregsău to Sânandrei. On the left of Beregsău, the plain penetrates through meadows and low terraces on the valleys that descend from the Lipovei Plateau, in the south-east corner crossing the terrace-glacis on the right of the Bega. Between the terrace plain of Bega (Lucarețului Plain) and the Vinga Plain, the conventional limit can be drawn on the Ghertiamoș Valley, between Ianova and Remetea Mare (where a north-south fault seems to pass – Posea, 1997). In the south, towards the Timiș Plain, the limit follows the 100 m curve, sometimes even 95 m. Although the altimetric difference makes the limit less noticeable, in the field there is, generally, a level of 15-20 m and locally of only 3-5 m, unevenness made by the movement of the wandering rivers of the semi-circular hydrographic collectors of the Vinga Plain after their penetration into the subsident plain, i.e., Beregsău. The Tormac-Gătaia Plain, located between Timiș - Pogăniș - Bârzava, has an average altitude of 155 m in the east that descends slowly to west-north-west up to 135-110 m, connecting the Ramna Hills and the low Timișului Plain through a field with lots of small depressions and strongly influenced by the tributaries of the Birda stream. The transition to the subsidence Plain of Timiș is marked by a decrease in the depth at which the pedo-phreatic waters are found. The relief falls in steps from east to west, thus constituting a transitional area between the structural erosive Piedmont relief from the interfluves to the fluvial accumulative relief and division of the low fields, ending quite suddenly on the line of the localities Folea - Liebling - Sacoșu Turcesc - Buziaș. Located between the Vinga Plain and the Tormac-Gătaia Plain, this plain is mostly a recent plain, which, at first sight, appears as a rather flat surface; carefully researched, it is found to have numerous levels represented especially by abandoned meanders, micro-depressions, and long tops of bank ridges (made up of coarse materials). This is largely due to the uneven deposits of alluvial materials during the big floods caused by Timiș and Bega, before regularization, sewerage and

damming, as well as subsequent compaction. Due to the varied micro-relief, the surface of the plain has numerous spring puddles after snow melting or in periods with heavy rainfall, puddles that disappear only by evaporation. Depending on the variation of the morpho-hydrographic and lithological nature of the generating agents, several subunits can be identified within it (Ţărău et al., 2016): the Cenei - Beregsău - Săcălaz Plain, the Peciu Nou - Parţa - Șag Plain, the Timișoara Plain, the Bega - Timiș and Timișană bay Plain. The Cenei – Beregsău - Săcălaz Plain is located on the western periphery of the vast dejection cone generated by Timiş, Bega and Beregsău.

The Peciu Nou - Parţa - Șag Plain is part of its alluvial islands and, partially, in the Bega Plain, it is present as an alluvial flow of subsidence fluvio-lacustrine plain, with waterbeds suspended above the field (elevated by the alluvia transported by the rivers that once crossed the area) and, between them, low, marshy lands with the groundwater near the surface. The cover of loessoid materials is interrupted by significant areas with soluble mineral soils, as a result of the "plugs" of harmful salts arising in the path of water circulation. The contact between the alluvial area of the Bega river and the lower terrace of Timiş covered with loessoid materials is done at the level of the sandy tops of bank ridge areas (the former fruit plantation from Diniaş, respectively the one from the Sânmartinul Sârbesc) and of the vast depressive areas in which salsodisol predominates. The salty lands (from an area of 4 ha), with their specific flora, located near the Diniaş, are protected as a pedological reserve (protected natural area, Law no. 5 of March 6, 2000), a measure initiated and promoted in the 1960s by C. V. Oprea. Among the plant species present in the reserve are *Plantago maritima* (sea plantain), *Artemisia santonica* (artemisia), *Atriplex tatarica*, *Atriplex littoralis*, *Myosurus minimus* (mousetail), *Trifolium fragiferum* (strawberry clover), *Lotus augustissimus* (lotus), *Aster tripolium* (sea aster).In the area of the reserve (in the areas with stagnant water that are formed in the spring - called, by the locals, bald-spots), vegetates an alga (cyanobacteria) known as the star jelly (Nostoc commune). The Timișoara Plain is, most of it, a subsidy and division plain made up of a succession of river tops of bank ridge and river depressing areas characteristic of a continental delta, bordered in north-east by a higher step with altitudes of over 100 m, a portion that connects, on the Giarmata Vii - Dumbrăviţa line, with the high Vinga Plain. Studied in detail, it presents a number of local features represented especially by abandoned meanders, micro-depressions and tops of bank ridges. The *Bega – Timiș and Timișană bay Plain*, an important part of the Timiş Plain within the studied area, is characterized by a wide development of the main river meadows, with numerous meanders, diffuses, separations and deserted courses and is made up of two divisions: the low interfluve plain of Bega (Canal) - Timiş and the low plain located north of the Bega Canal, but having a great unevenness, both relief and parental materials, thus favouring swamping, for which since the 18th century they started doing the first works of regularization, sewerage, damming, and drainage. The Timișană Plain has large interfluves with slopes; it forms an intermediate step between the low Timiș Plain and the hilly plains (the Tormac - Gătaia Plain) within the studied area, i.e., the Buziaș Hills, where they make up bays. The transition from the hilly and pre-hill sector to the Timiș Plain is made by a succession of terraces with different widths. The geological past of the studied area is linked to that of the Banato - Crișană Plain, of which it is part, representing one of the eastern portions of the great sedimentation called the Pannonia Depression that sank along the alignments of ancient north-south faults, more to the west and fewer towards the Carpathians, starting with the Badenian, with a maximum during the Pannonian, after which it became slower (Ianoş et al., 1999), their presence being marked south from Gătaia by volcanic hillock Șumig or by the formation of the Lada-Bara laccolite along the Vinga - Seceani - Ianova alignment, as well as the mineralized waters from Calacea, Buziaş or Ivanda. From a lithological point of view, the cadastral territory is characterized by a succession of layers of different age, thickness, and granulometric composition depending on the forms of mezo- and micro-relief, the tops of bank ridges being made up of coarse texture deposits. Mihăilă et al. (1988), analysing

drilling data, indicated four lithological complexes deposited under different sedimentation conditions. The first is made up of small gravel and sands with clays and very thick sandy clays (160-180 m) that were deposited directly on the Pannonian. The age of the complex is estimated from the upper Pliocene to the Medium Pleistocene. The fourth complex brings together superficial deposits throughout the plain, different in origin and age: loess and loessoid deposits, fine sands and clays, red clay (Upper Pleistocene). Florea et al. (1966) established a number of five red strips - fossil soils in the deposits of this field. The lithology of surface materials is generally represented by alluvial-calcic and wind formations, but especially Pleistocene ones. Quaternary sedimentary deposits have the highest development in the area, covering all the other geological formations with frequent thicknesses of 100-200 m. The important thickness of these deposits attests the extent that they had during the Quaternary the erosion, transport, and accumulation processes, at the same time with the phenomena of subsidence that affected the entire Pannonia basin, including the studied area. Over the basic gravel, follows an alternation of sands of different granulations, gravels, clays, sandy clays, marls, sandy marls, sediments that represent the deposits of several generations of dejection cones of Mureș and Timiș rivers, which have successively changed their courses as a result of the continuous subsidence in the Pleistocene (Mihăilă, 1989; Uruioc, 2002).

Hydrologically, the studied area is part of the group of south-western hydrological systems, the Timiş - Bega hydrographic basin, the complex hydro-meliorative system Șag - Topolovăț, with a rich hydrographic network consisting of rivers, lakes, and canals. The course of the Bega river, the most southern tributary of the Tisa, is characterized by a water regime with very large variations of water levels and flows. Under these conditions, both to ensure the need for water to the waterway (started in 1728, on a route of the old course, completed in the first phase in 1756), as well as to protect the municipality of Timișoara (after the great flood of 1859), Bega was linked to Timiş through a system consisting of two canals. Thus, the hydrotechnical node from Coştei was conceived and realized, with the main function to ensure the transfer of water quantities from Timiș to Bega, depending on the needs and the amount of rainfall taken from the two rivers upstream. Beregsău springs from the Lipovei Hills (Ujvari, 1972), after which it descends east from Fibiș and Pișchia, respectively south from Cernăteaz and gathers most of the waters from the Vinga Plain, among which Măgheruș (both seem established on the old courses of the Mureș). The current course of Beregsău being regularized and turned into a canal, the flooding of the meadow takes place very rarely, only during the big floods. In the eastern part of the locality of Seceani all the valleys converge towards Măgheruș, so that Luda-Bara, an important tributary of Măgheruşului, gathers its water from the Seceani platform; after crossing from the north to the south of the village of Murani, it flows from north-west to south-west almost in parallel with Măgheruș. In rainy autumns and springs, the whole meadow is flooded for a long time. There, on an area of 200 ha located in the eastern part of Murani village, near the county road (DJ 693) that connects the town of Pișchia to Seceani, near the A1 highway, Bucharest - Nădlac (part of the IV Pan-European corridor) was included in a natural area. The Murani Marshes make up an area of special avi-faunistic importance due to the presence of several (migratory) bird species protected at European level through the EC Directive 147/EC of November 30, 2009 (on the conservation of wild birds. In the western part of Calacea, the area is drained by Apa Mare, around Carani by the Surduc Valley, and around Corneşti by Valea Lacului. Then, there are a series of valleys that change their direction several times from the springs to Beregsău. Apa Mare, which originates under the peak Luda Bara on the territory of Fiscut (commune of Şagu), has a well-drained valley from its entrance to Vinga to the place where the Arad - Timișoara road crosses. From the road to the centre of Vinga, it has low-drained partially soaked portions, and from there to the communal road leading to Secusigiu, it becomes a large marshy area with reeds. In the flooding meadows, because of the digressing watercourses, there are a number of ponds and

marshes with developed grassy vegetation, especially in the perimeter of the Apa Mare meadow, declared a natural ornithological reserve, the area protecting a specific habitat for the aquatic fauna, especially (*Isobrycus minutus*), great crested grebe (*Podiceps cristatus*), spoonbill (*Platalea leucordia*), great egret (*Egretta alba*), little egret (*Egretta garzetta*), western march harrier (*Cyrcus aeruginosus*), European bee-eater (*Merops apiaster*), European pond turtle (*Emys orbicularis*), a reptile, as well as many other species of protected birds. Satchinez Marshes form an ornithological nature reserve that covers 242 ha in the border of Satchinez. It was established in 1942, at the proposal of the ornithologist Dionisie Linția, comprising marshy lands downstream (Journ. Cons. Min. No. 1166/1942). Currently, the reserve has an area of 1,194 ha, being nicknamed the "Banat Delta", with 40% of the bird species found on the territory of Romania living there. This natural habitat is a reminiscence of the old marshes that covered these lands until the middle of the 8th century. From the Lipovei Hills, the Gherteamoş stream is poured into Bega, crossing the studied area north-east to the west close to Ianova, then goes to southwest, collecting the waters of the erosion valleys and the torrential elements in the Piedmont area Stanciova – Herneacova – Ianova, in a fanlike pattern. Within this course, east of Innova, an accumulation lake was made, with a water surface of 10-15 ha, which represents an attractive area for recreational fishing enthusiasts. After leaving the territory of our country, Bega flows into the Tisa at Titel, in Serbia, but before that it also receives the waters of Bega Veche (Beregsău). Timişul (called in the Roman period Tibisis or Tibiscus, a name that could come from the Dacian "thibh-isjo" meaning marsh), the most important hydrographic artery in Banat, collects its waters from a river basin of 5248.0 km^2, 241.2 km in length. The lower course of Timiş starts from Coştei, from where it forms a wide valley, with numerous meanders, digressions and ponds, phenomena favoured by the very small slope and the depth of water-clayey deposits. Great hydrotechnical works started in the 18th century created the Bega-Timiş drainage and navigation system through canalling, regularization and damming of the courses of the two rivers, removing their lower basins from floods. Of the tributaries received by Timiş in its lower basin, the most important is Pogăniş, which, after it springs from the northern part of the Semenic Mountains, collects the waters from the hills of the same name, constituting a collection basin of 700 km^2 and a length of almost 100 km, the place of flow into the Timiş being on the territory of the commune of Sacoşu Turcesc, Timiş County, at the north-western limit of the village of Uliuc. The drainage regime, with strong floods that used to cause numerous floods, led to the regularization and damming of the riverbed. Part of the Pogănișului Meadow, especially the area of Tormac, Blajova and Berini, with an area of 75.5 ha, was declared a nature reserve, its objective being to protect the spotted tulip (*Fratillaria ileagris*), a Mediterranean species from the Liliaceae family (Nica, 2004; Banaterra.eu). The current hydrographic aspect completely different from the one in the not-too-distant past is the result of important hydro-meliorative works started over 250 years ago.

The climatic peculiarities of the studied area are determined by its geographical position so that it is characterized by a temperate moderate continental climate with shorter and milder winters, being frequently under the influence of cyclones and air masses that cross the Mediterranean and the Adriatic Sea. From a phytogeographic point of view, the studied area belongs to the central European geobotanical province, strongly influenced by the vicinity of the South-European geobotanical province. Thus, the natural floristic elements have different geographical sources: European, Euro-Asian, Boreal, Balkan, Mediterranean, Illyric, to which a series of endemic plants can be added. In this sense, floristic research in the studied area (and of course, in a larger area) were published by Fr. Griselini (1779) who, living between 1774 and 1777 in Timișoara Banat, wanted to inform in his 21 letters, the (science) world about the many aspects that drew his attention in this ancient Romanian province. In his 12th letter, Griselini makes a thorough description of the natural frame, relief, springs, and rivers that cross it, soil nature, and vegetation, etc. The landscape is

diversified by the existence of small, solitary patches located near the former courses of the waters, or along former access roads, made up of *Salix fragilis* L., *Acer tataricum* L., *Robinia pseudacia* L. and, rarer, *Quercus cerris* L., *Quercus pedunculiflora* Koch. Bistra Forest with an area of 19.90 ha, located in the meadow on the left bank of the Bega river, 12 km from Timisoara, was declared an area protected by Law no. 5 of March 6, 2000 and represents an area foreshadowed protection for pedunculate oak (*Quercus robur*), Hungarian oak (*Quercus frainetto*) or Austrian/Turkey oak (*Quercus cerris*). Also, in the Bega meadow, there is the Bazoș dendrological reserve that extends over 60 ha. It includes Parcul Mare, Parcul American and several nurseries intended for the cultivation of exotic species. From 1994, the protected area was declared for the protection of biodiversity, gene fund, eco-fund and for maintaining the ecological balance in Timiș County. It is part of the International Association of Botanical Gardens. From the data presented, it can be observed that the diversity of the pedo-climatic conditions and the local particularities of the studied area had a strong influence on the structure of the land fund and of the land use, in general, and of agricultural lands (implicitly on their current and future productivity). To our regret, we do not have sufficient statistical data to be able to follow the evolution of land uses, but we could appreciate their dynamics guiding us after the natural vegetation areas and reconstructing the map of the old supposed uses (Coste et al., 1997; Coste, 2003).

It may be that, until the beginning of the 19th century, the areas remained almost unchanged, except for a slight decrease in forest areas. The bigger changes began there, as in the other regions of the country, after 1829, after the Treaty of Adrianople, when the trade with grain and wood was liberalized. However, the most radical changes in the use of the land in the last 250 years have taken place in the plains, where large areas of marshes have been transformed into arable land and pastures, with them also occurring areas of poor salty soils.

At the same time, the plain areas were densely populated, and the works of regularization, sewerage, drainage, and damming led to the improvement of the land and to an increase of the economic significance of these areas compared to the hilly ones. Drainage works reduced the areas of lakes and ponds, in general, of hydrophilic and hygrophile ecosystems, from 10,926 km^2 to areas of several tens of square kilometres; currently, there are aridization tendencies by decreasing the level of pedophreatic waters (Man, 2015)

According to the Romanian soil taxonomy system (SRTS-2012) with 12 types (Table 2) and soil associations identified, which mirror, by their geo-bio-chemical and morphological properties the main defining and determining characteristics for the growth and fructification of the main cultivated plants, expressed by grade.

Table 2. Main types of soil (ha/%)

	UAT	Agricultural ha	AS	CZ	FZ	EC	EL	LV	VS	PE	SG-GS	SN	AT*-TT	Asoc.
1	Timişoara	4341	343	864	0	1190	0	0	703	561	0 50	0	630	0
2	Becicherecu Mic	4217	70	2846	0	640	104	0	96	64	0 25	130	18	224
3	Biled	4946	0	4543	0	0	0	0	10	0	0 194	49	0	150
4	Bucovăţ	2826	285	0	0	1967	0	0	254	79	0 0	241	0	0
5	Chevereşu Mare	5988	132	0	0	379	4106	0	146	180	0 828	0	217	0
6	Dudeştii Noi	4776	0	3310	296	250	94	0	113	145	0 37	125	35	371
7	Dumbrăviţa	596	0	303	0	32	255	0	0	0	0 0	0	6	0
8	Ghiroda	2812	194	0	0	132	1530	0	315	36	67 200	20	0	318
9	Giarmata	6531	99	0	69	949	3688	0	478	858	98 249	0	43	0
10	Giroc	3903	458	0	0	2378	0	0	53	0	0 493	0	0	521
11	Jebel	6225	320	626	2275	2198	0	0	214	0	0 280	312	0	0
12	Liebling	7774	26	1978	0	11	3742	0	515	0	330, 985	126	3	58
13	Maşloc	6965	0	0	77	100	5658	0	380	185	280 86	0	199	0
14	Moşniţa Nouă	4665	1302	0	0	1640	0	0	1018	0	0 451	13	0	241
15	Orţişoara	13768	0	2193	0	0	8444	317	0	0	200 407	0	1007	1200
16	Parţa	5560	1024	407	638	2973	0	0	14	112	0 0	8	8	376
17	Pădureni	3740	189	368	1338	1357	0	0	126	0	0 179	183	0	0
18	Peciu Nou	12188	115	3983	1938	1885	0	0	864	1203	0 73	1103	11	1013
19	Pişchia	9696	27	0	0	999	6893	98	411	115	247 259	0	647	0
20	Recaş	19658	1579	0	29	4618	6521	1460	956	504	410 490	0	3032	59
21	Remetea Mare	5956	155	0	2007	1114	360	352	300	1144	346 131	0	47	0
22	Sacoşu Turcesc	11068	273	1445	3023	1814	3092	0	768	0	0 153	121	0	379
23	Satchinez	8925	428	6694	0	0	696	0	54	0	0 643	62	348	0
24	Sânandrei	8227	0	1277	0	552	4301	14	600	0	0 197	29	471	786
25	Săcălaz	10622	985	3719	617	2951	0	0	478	1320	0 249	303	0	0
26	Sânmihaiu Rom	6841	1446	774	0	177	0	0	2023	0	0 132	65	0	2224
27	Şag	2751	513	203	319	1461	0	0	7	55	0 0	2	4	187
	Suprafaţa	185565	9963	35533	12626	31767	49484	2241	10896	6561	1978,6791	2892	6726	8107
	%	100	5.36	19.14	7.00	17.10	26.63	1.21	5.87	3.51	1.07 3.65	1.56	3.63	4.36

The basic principle of the assessment method elaborated in our country is the one after which, for each homogeneous ecological unit (HEU) within a territorial administrative unit (TAU) defined according to the current methodologies for elaborating pedological studies, using the 23 indicators of value - *climatic indicators* (indicator 3C - average annual temperature - corrected values, indicator 4C - average annual rainfall – corrected values), indicators of some morphological, chemical, physical, hydro-physical characteristics and the volume of the soil cover (the indicator 14 - gleysation, indicator 15 - stagno-gleysation, indicator 16 or 17 - salinization or alkalization, indicator 61 - $CaCO_3$ content total on 0-50 cm, indicator 63 - soil reaction in the water or in the first 20 cm, indicator 144 - humus supply in layer 0-50 cm, indicator 23A - texture in water or first 20 cm, indicator 44 - total porosity in restrictive horizon, indicator 133 - useful edaphic volume), *indicators of relief characteristics* (indicator 33 - slope, indicator 38 - glides), indicators related to hydrography, hydrology and drainage of the territory (indicator 40 - flooding, indicator 181 - excess stagnant humidity, indicator 39 - depth of the pedo-phreatic water), *indicators of some anthropic interventions* (indicator 29 - pollution, indicator 271 - land improvements) as well as the interactions between the values of natural an anthropic features are turned into well-established value grades from 1 to 100, which support the quality classes from I to V (Table 3) depending on their suitability for arable use (Order M.A.D.R. no. 278/201), the situation being specific for each territory taken into account.

Table 3. Quality classes for "ARABLE"

Territorial Administrative Unit (TAU)	Arable	Class I (81-100 pts.) ha	Class II (61-80 pts.) ha	Class III (41-60 pts.) ha	Class IV (21-40 pts.) ha	Class V (1-20 pts.) ha	Levelled average grade
1. Timişoara	4088	146	1889	789	960	304	58
2.Becicherecu Mic	3545	1298	1303	507	220	217	69
3. Biled	4467	2375	1780	260	47	5	76
4. Bucovăţ	2358	81	827	1092	343	15	56
5. Chevereşu Mare	4371	0	1435	2572	350	14	57
6. Dudeştii Noi	3515	1160	1402	500	230	223	68
7 .Dumbrăviţa	543	245	287	7	4	0	69
8. Ghiroda	2241	0	1035	957	229	20	59
9. Giarmata	5977	128	924	3860	949	116	50
10. Giroc	3580	15	715	1990	653	207	47
11. Jebel	5315	305	2758	1674	454	124	59
12. Liebling	6671	722	1216	2298	1799	636	**55**
13. Maşloc	5175	78	762	2812	1260	263	48
14.Mosnita Noua	4097	146	1790	1855	253	53	58
15.Orţişoara	11610	1499	5273	3677	594	567	63
16. Parţa	4845	90	2200	1832	649	74	57
17. Pădureni	2753	160	1420	881	230	62	59
18. Peciu Nou	9113	425	4998	2663	440	587	60
19. Pişchia	7203	157	2977	2327	1389	353	54
20. Recaş	12121	0	1959	4984	3865	1313	42
21.Remetea Mare	4815	49	962	2473	967	364	53
22. Sacoşu Turcesc	9202	174	3748	3529	1674	77	57
23. Satchinez	8027	4127	2256	664	442	538	70
24. Sânandrei	6986	317	4026	1918	708	17	64
25.Săcălaz	9438	298	3967	2992	1747	434	57
26.Sânmihaiu Român	5335	192	1373	1150	2414	206	46
27.Şag	2467	46	1108	960	320	33	57
Total ha	149858	14233	54390	51223	23190	6822	
%		9.50	36.29	34.18	15.47	4.56	

The operation of classifying agricultural lands into quality classes based on the notes of value has highlighted a series of limiting factors that act on the production capacity of agricultural lands within the studied area, including: granulometric composition (soil texture), humus supply, soil reaction, degree of tingling or compactness, excess humidity; some of them are exemplified by the affected areas (Tables 4-6), and they refer to the limitations caused by the excess stagnant and groundwater (Table 4), poor and/or acidification of the soil (Table 6), respectively the degree of compaction and the deficit of humidity, for which, on a case-by-case basis, pedo-hydromeliorative measures (drainage, deep aeration, etc.) of achieving a balance airo-hydric regime and measures meant to favour the development of the processes of concentration of nutrients and organic matter in the soil (meliorative fertilization, long-term crop rotations with meliorative plants and perennial grasses, etc.) are required.

Table 4. Situation of land with excess surface and groundwater humidity

Nr. crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			Excess surface excess			*exces de umiditate freatică*		
			low	*moderate*	*high; excessive*	*low*	*high*	*very high; excessive*
1	Timişoara	4341	1270	111	0	2001	111	561
2	Becicherecu Mic	4217	923	1135	756	1190	390	290
3	Biled	4946	0	0	0	852	367	23
4	Bucovăţ	2826	767	560	230	950	265	241
5	Cheveresu Mare	5988	1566	2574	79	969	60	879
6	Dudeştii Noi	4776	990	1250	826	1280	560	320
7	Dumbrăviţa	596	135	95	-	65	7	0
8	Ghiroda	2812	201	80	-	261	230	235
9	Giarmata	6531	1059	950	596	825	495	250
10	Giroc	3903	1084	323	617	352	2495	519
11	Jebel	6225	160	77	0	1671	509	280
12	Liebling	7774	1980	1320	360	1757	1240	1104
13	Maşloc	6965	1106	1740	1040	340	99	124
14	Moşniţa Nouă	4665	1267	1120	890	980	680	455
15	Orţişoara	13768	1360	820	360	1120	350	415
16	Parţa	5560	25	990	360	1100	400	0
17	Pădureni	3740	950	120	0	1560	1020	179
18	Peciu Nou	12188	1690	1120	920	3119	2605	418
19	Pişchia	9696	1410	1076	506	950	390	260
20	Recaş	19658	3463	2454	750	1165	1845	650
21	Remetea Mare	5956	1550	1150	510	2560	620	255
22	Sacoşu Turcesc	11068	2960	1870	250	2960	2470	217
23	Satchinez	8925	1420	1387	219	1120	828	750
24	Sânandrei	8227	1690	960	512	1155	720	207
25	Săcălaz	10622	1280	2524	930	2223	981	266
26	Sânmihaiu Român	6841	1100	2250	870	644	668	132
27	Şag	2751	33	1070	395	1138	341	0
	Surface ha	185565	31539	26078	11976	34307	18251	9030
	%		17.00	14.05	6.45	18.48	9.84	4.87
	Surface ha/%		69,593 ha, 37.50%;			131,181 ha, 70.69%		
	Surface ha/%		61,588 ha, 33.19%;					

Thus, within the lands located in the Banato-Crişană Plain in relation to the form of micro-relief, permeability, and hydroclimatic balance, agricultural land can be grouped (according to indicator 181 of M.E.S.P., 1987 - excess surface humidity) depending on the period of stagnation (Table 5) as follows: low (2), with stagnation between 6-15 days, on 31,539 ha, 17.00%, moderate (3), with stagnation between 16-30 days, on 26,078 ha, 14.05%, high (4), very high (5) and extremely high (6), for periods that can exceed 60 days, with an area of 11,976 ha, 6.45%, representing together limiting factors on an area of 69,593 ha, 37.50%. Referring to the water regime of the soil, predominantly groundwater, the state of gleysation, or the excess of pedophreatic humidity, within the area investigated in relation to the intensity of the gleysation and the depth at which it appears were defined the grades of gleysation (indicator 14) resulting in the following land groups (Table 5): moderate (3), on 34,307 ha, 14.48% (of the studied area), high (4), on 18,251 ha, 9.84%, very high (5) and excessive (6), on 9,030 ha, 4.87%, representing limiting factors on an area of 61,588 ha, 33.19%. The two forms of excess humidity within the studied area represent limiting factors on an area of 131,181 ha, 70.69% (Table 5). One of the soil features with an important role in the way of excess and deficit of humidity occurs is compactness. This represents the property of the soil to oppose the forces that tend to mechanically undo the particles that make it. It is closely linked to granulometric composition, water content, humus content and its quality, as well as to the nature of adsorbed cations, the main ecological indicator that impacts the general way of working the soil with agricultural equipment and the plant root penetrating the soil. It is expressed in percentages, establishing the classes of soil compactness: very loose, loose, low compactness, moderate compactness, high compactness, features closely related to a complex indicator – the degree of compactness (indicator 44), which shows that, within the studied area, there is the following situation (Table 5): high (+25) on 59,596 ha, 32.12%, moderate (+15) on 71,975 ha, 38.79% and low (+5) on 26,683 ha, 14.38%, representing limiting factors on 158,254 ha, 85.29%.

The general compaction of the soil profile (Table 5) impacts the methods of retention and movement of water from the soil, the water retention force, which influences its accessibility for plants being constantly changing, depending on the degree of humidity of the soil (generated either by the water from precipitation, or by the pedophreatic intake and the degree of compaction, or by the relief form), for which, within the agricultural lands with an area of 185,565 ha, within the studied area, during one agricultural year, we encounter

two extreme situations, respectively: excess moisture in the cold season on 158,254 ha, 85.29% (Table 5) and humidity deficit during hot years on 97,871 ha, 52.74% (Table 6).

Table 5. Situation of land affected by compaction and humidity deficit

Nr. Crt.	Commune Town Municipality	Total ha (agricol)	Of which lands with:					
			compactation			*Humidity deficit*		
			low	*moderate*	*high*	*low*	*moderate*	*high; excessive*
1	Timişoara	4341	104	1019	1515	1250	169	0
2	Becicherecu Mic	4217	848	3065	574	249	2251	0
3	Biled	4946	3354	435	65	1149	1268	0
4	Bucovăţ	2826	526	480	1270	1280	-	-
5	Chevereşu Mare	5988	2351	2055	1094	1904	2295	-
6	Dudeştii Noi	4776	948	3285	595	270	2550	0
7	Dumbrăviţa	596	265	150	180	356	-	-
8	Ghiroda	2812	201	2052	151	528	1278	-
9	Giarmata	6531	390	5550	340	1990	2710	490
10	Giroc	3903	1125	952	1236	991	1685	0
11	Jebel	6225	1513	1552	1570	496	1511	0
12	Liebling	7774	128	5453	1768	3222	2651	-
13	Maşloc	6965	525	226	6058	2640	3189	-
14	Moşniţa Nouă	4665	870	1140	2430	560	3150	-
15	Orţişoara	13768	180	7260	4160	1860	3960	2168
16	Parţa	5560	1020	2860	960	1260	0	0
17	Păduren i	3740	620	820	1517	360	1220	0
18	Peciu Nou	12188	1725	3812	3080	2960	1743	0
19	Pişchia	9696	2885	1760	4210	1960	2890	-
20	Recaş	19658	450	5060	9960	1860	6170	-
21	Remetea Mare	5956	939	870	3406	2690	-	-
22	Sacoşu Turcesc	11068	458	8379	1246	1790	5280	-
23	Satchinez	8925	1508	1470	1730	1884	2276	977
24	Sânandrei	8227	320	1010	6085	1980	2970	210
25	Săcălaz	10622	1217	6143	2073	1666	30	0
26	Sânmihaiu Român	6841	1112	3643	1915	1121	797	0
27	Şag	2751	1101	1474	408	1747	0	0
		185565	26683	71975	59596	41983	52043	3845
			14.38	38.79	32.12	22.62	28.05	2.07
			158,254 ha, 85.29%;			97,871 ha, 52.74%		

Referring to the state of soil reaction (indicator 63), as a result of the complex of physico-chemical properties in its natural or anthropic state, which expresses the ways in which the main biochemical processes of the soil determining the possibilities of growing and developing cultivated plants or those in natural biocoenoses, it presents altitudinal zoning from west to east (values decreasing with altitude), from the salsodisols of the subsidence plain to the strong acidic soils in the Piedmont areas. Depending on these values, the following groups of land can be identified (Table 6): *strong acidic* (4.7 with values between 4.4-5.0) on 3,924 ha, 2.11%, *moderately acidic* with values between 5.1-5.4 (5.2%) and values between 5.5-5.8 (5.6%) on 13,738 ha, 7.40%, *low acidic* with values between 5.9-6.8 (6.1-6.6) on 23,261 ha, 12.54%, representing limiting factors on 40,923 ha, 22.05%.

Table 6. Situation of land affected by salting and acidification

Nr. Crt.	Commune Town Municipality	Total ha (agricultural)	Of which lands with:					
			Salting			*acidifiere*		
			low	*moderată*	*Ptr. exce*	*low*	*moderate*	*High;*
1	Timişoara	4341	1805	405	50	1121	174	0
2	Becicherecu Mic	4217	1527	1384	133	601	102	0
3	Biled	4946	1705	1070	69	280	0	0
4	Bucovăţ	2826	40	-	-	1100	960	-
5	Chevereşu Mare	5988	460	230	-	3810	980	-
6	Dudeştii Noi	4776	1690	1760	130	730	104	0
7	Dumbrăviţa	596	-	-	-	340	20	-
8	Ghiroda	2812	40	377	20	1470	330	-
9	Giarmata	6531	940	-	-	1529	1670	70
10	Giroc	3903	701	21	0	1344	317	15
11	Jebel	6225	650	580	655	1555	348	0
12	Liebling	7774	935	55	136	4850	460	-
13	Maşloc	6965	-	-	-	1930	2726	-
14	Moşniţa Nouă	4665	125	498	13	1480	2060	-
15	Orţişoara	13768	80	60	-	4550	5650	13
16	Parţa	5560	317	126	8	1620	260	0
17	Păduren i	3740	630	735	183	960	360	0
18	Peciu Nou	12188	2223	986	1103	1663	422	0
19	Pişchia	9696	191	-	-	3195	4370	145
20	Recaş	19658	-	-	-	4280	11720	195
21	Remetea Mare	5956	10	-	-	2590	2395	16
22	Sacoşu Turcesc	11068	360	250	125	5958	2930	-
23	Satchinez	8925	620	506	68	4810	980	-
24	Sânandrei	8227	1050	670	29	2160	3450	135
25	Săcălaz	10622	4667	2679	837	1383	48	0
26	Sânmihaiu Român	6841	2375	1246	363	1680	326	0
27	Şag	2751	120	100	2	1320	396	0
		185565	23261	13738	3924	58309	43558	589
			12.54	7.40	2.11	3.42	23.47	0.32
				40923	22.05		102456	55.21

The soils included in the category of acid soils can be separated into two major groups regarding the type of acidification and soilification, with implications on the aerohydric regime. In a first group are the soil types that have horizon B clay-illuvial (Bt) and, in the second, soils with horizon B cambic (Bv) or spodic (Bs). The low fertility of acid soils is mainly caused by acidity, the presence of free aluminium in the soil solution, the deficiency of nutrients, and the defective aerohydric regime. Referring to the lands affected by salting (Table 7), the following groups of land resulted: *low alkaline* with values between 7.3-7.8 (7.5%), values between 7.9-8.4 (8.1%) on 58,309 ha, 31.42%, *moderate alkaline* with values between 8.5-9.0 (8.7%) on 43,558 ha, 23.47%, *high and excessively alkaline* with values between 9.1-9.4 (9.2%) on 589 ha, 0.32%, representing limiting factors on an area of 102,456 ha, 55.21%: solonetz, vertosols, pelosols, eutricambosols, chernozem (salsodic sub-types, etc.).

CONCLUSIONS

Overall, the relief of the studied area is characterized by a great complexity of morphological forms, with geological structures and specific pedo-geographic evolutions, related to the genesis in time and space of the Banato-Crișană Plain, of which it is part. The other feature is generated by the withdrawal of the Pannonia Lake, which left behind a vast and unhealthy area maintained until the end of the 18th century, during which 877,600 ha of marshes persisted, periodically fed from the many arms that were detached from the rivers transiting the area. The great structural and economico-social diversity determined mostly by the relief forms is also mirrored in the distribution of agricultural lands, which gives the Banat area a specific feature, in which the intensity of land fund use is close to maximum parameters, 82,86 % from the total area being used in different activities specific to agriculture (cereals, technical plants, etc., with 80,76 % being arable land). This is due, to a large extent, to the first works of drainage of the marshes and to the regularisation of the main rivers such as Beregsău, Bega, Timiş, Bârzava, etc., started in 1711-1728, and continued with other pedo-hydro-meliorative works until recently. eferring to the natural and anthropic conditions in the physico-geographical area located in the medium and inferior basins of the main courses - Bega, Timiş, Bârzava - these are, generally, favourable for the development of the agri-food sector, under all aspects, with an old tradition of cultivation of cereals and their capitalisation. However, we need to emphasise that, being located in the subsidence, divagation, and accumulation of Mureș, Timiș, and Bârzava rivers, the geomorphological evolution of the area studied is related to the evolution in time of the marine (Thetys) or lake (Pannonia) domains which generated the formation of soils (vertosols, pelosols, stagnosols, salsodisols, vertic-salsodic chernozes, etc.) which, during one agricultural year, have two extreme situations, respectively: excess of humidity in the cold season and deficit of humidity during the hot period of the year, both situations generating a series of stress forms with negative effects on the productivity and quality of the agroecosystems, which imposed the achievement in the area of agro-pedo-hydro-meliorative arrangements, the area being subjected, from its beginnings of local formation organisation, to more intense anthropic interventions than in other territories of the Timiş County.

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