

QUALITY STATE OF SOILS FROM WEST OF ROMANIA AND MEASURES FOR THEIR FERTILITY RESTORATION

STAREA DE CALITATE A SOLURILOR DIN VESTUL ROMÂNIEI SI MASURILE DE RESTAURARE A FERTILITĂȚII ACESTORA

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Abstract The sustainable management of natural and anthropic resources represents a modern form of land management, which has the aim to maintain and increase the soil fertility and to permit on long term the obtaining of high quality food productions. In the paper are presented the main aspects about natural resources, with special reference to soil cover and its quality state, from the western part of Romania, having a surface by 2,3 millions ha, from which 17 millions ha are agricultural lands. There are succinctly but comprehensive presented aspects referring to the structure of edaphic cover, respectively some restrictive characteristics of their fertility: supplying state with nutrients (N, P, and K), reaction state etc. Finally, basing on obtained results there was presented some aspects referring to several measures necessary for restoration of soils fertility.

Rezumat Gospodărirea durabilă a resurselor naturale și a celor induse antropice, reprezintă o formă modernă de management al terenurilor, care are menirea de menținere și sporire a fertilității solurilor și de a permite pe termen lung obținerea unor producții de alimente de înaltă calitate. În lucrare sunt prezentate principalele aspecte legate de resursele naturale, cu referire specială la învelișul de sol și starea de calitate a acestuia, din zona de vest a României, în suprafață de peste 2,3 milioane ha, din care 1,7 milioane ha terenuri agricole. Sunt redată succint dar cuprinzător aspecte referitoare la alcătuirea învelișului edafic, respectiv unele caracteristici restrictive ale fertilității: starea de aprovizionare în principalii nutrienți (N, P, K), starea de reacție etc. în final, pe baza rezultatelor obținute sunt prezentate câteva aspecte referitoare la o serie de măsuri de restaurare a fertilității acestora.

Key words: quality, edaphic, fertility, restoration, resources.

Cuvinte cheie: calitate, edafic, fertilitate, restaurare, resurse.

INTRODUCTION

The sustainable management of soils requires in the case of agricultural and forest land management to take into account the cycles and fluxes of information, energy and substance between soils and the other sphere of the environment (atmosphere, hydrosphere, lithosphere and biosphere).

In FAO terminology, the "land quality" is defined as a complex of factors which influence the sustainability of the land. According to this terminology, the term "terrain" is referring to: soils, relief forms, vegetation, fauna, including as well the land improvements and other forms of management (FLEISCHHAUER and EGER, 1998, quoted by M. DUMITRU, 2002).

Land (lands) quality, in acceptance of pedology school from Romania, represents the totality of essential characteristics and particularities of soils, defined from the viewpoint of topography, geodesy, geology, geomorphology, pedology, agrochemistry, technology, improvement etc. which make a land part from surface of Terra different from another one, being better or worse.

Starting from these reasons, basing on data collected from the scientific research, as well as data from OSPA archive (Timișoara, Arad, Oradea) and from national system of

monitoring organized by ICPA Bucharest, in connection with other European systems, the authors try to present in this paper a few aspects referring to quality state of lands, especially of soils, as essential elements in establishment of measures necessary for fertility restoration.

MATERIAL AND METHOD

The approached problematic is referring to a surface by 2.300.571 ha that represents the counties Timiș, Arad and Bihor, from which 1.713.370 ha are agricultural lands. The study of ecopedological conditions, ordering and processing of data were made in accordance with "Methodology for Elaboration of Pedological Studies (vol. I, II, III)", developed by ICPA Bucharest in 1987, completed by Romania System of Soils Taxonomy (SRTS-2003).

RESULTS AND DISCUSSIONS

The geographical position within the continent and the presence of Carpathian Mountains in the eastern part make in the researched area to interfere geographical influences by different origin: central-European, eastern-European and Balkan, resulting a big diversity of ecological conditions, determined by the large variability of all factors (cosmic-atmospheric and telluric-edaphic) which compete to realize the environment for plants growth and cropping.

Thus, according to atmospheric circulation, the soils within the researched area are placed in the zone where the wet air masses from west are imbedding with continental dry masses, which determine a temperate-continental climate, with Mediterranean influences from the south of Europe.

The large spectrum of relief forms is characterized by a great complexity of morphological forms, from river meadows and old deltas (with 60-80 m altitude) to semi-drained plains (80-100 m), alluvial plains, plateaus, high hills, intra or extra-mountainous depressions, and mountains with altitudes that can reach 1486 m (Gaina Peak from Bihor Mountains). The disposition in steps of the relief forms determines the distribution on vertical line of all elements of the environment, fact that is reflected in the stratification vegetation. Thus, in the area of low plain from the north-west of territory, can be distinguished the steppe and sylvosteppe, then plain forests, hill forests and mountain forests, with genus *Quercus*, *Fagus* and coniferous trees, and, on the mountainous peaks, alpine and subalpine pastures.

Table 1

The structure of surfaces for the main use categories

Specification	Arable	Pasture	Hayfields fields	Vineyards	Orchards	Agricultural	Forests	Other	TOTAL
TIMIȘ (ha)	530215	129231	29279	4347	9326	702398	109017	58250	869665
%	60.97	14.86	3.37	0.49	1.07	80.76	12.54	6.70	100.0
%	75.49	18.40	4.17	0.61	1.33	100.00	-	-	-
ARAD (ha)	348324	128102	25293	3814	5987	511520	212182	51707	775409
%	44.92	16.52	3.26	0.49	0.77	65.96	27.37	6.67	100.0
%	68.09	25.04	4.95	0.75	1.17	100.00	-	-	-
BIHOR (ha)	303097	138432	42698	5174	10051	499452	194835	60140	754427
%	40.18	18.35	5.66	0.68	1.33	66.20	25.87	7.97	100.0
%	60.09	27.72	8.55	1.03	2.01	100.00	-	-	-
TOTAL (ha)	1181636	395765	97270	13335	25364	1713370	516034	71167	2300571
%	51.36	17.21	4.23	0.58	1.10	74.48	22.43	3.09	100.0
%	68.96	23.10	5.68	0.78	1.48	100.0	-	-	-

The relief particularities and pedoclimatic conditions led that arable land to hold 68,96 % from the agricultural surface, respectively 51,36 % from the researched area. In this sense, Timis County is remarking with 75,49 %.

Pastures represent 28,78 % from agricultural surface, respectively 21,44 % from the surface of researched area, Bihor County being remarked with 36,27 % (pastures 27,72 %, hay fields 8,55 %). Plantations with vineyards and orchards represent 2,26 % from agricultural surface, respectively 2,26 % from researched area. Forestry found is structured in forests which are comprised in forest planning and other terrains with forest vegetation and represents 22,43 % from the studied area. Over medium are Arad County with 27,37 % and Bihor County with 25,87 %, and below medium is Timis County with only 12,54 %. In close correlation with diversity of relief forms, with variability of climatic conditions, with category of use, the soils from the researched space present a great diversity, in a continuous evolution, being identified, in accordance with SRTS-2003, 23 types of soils (table 2), which are distinct different by their properties, productive capacity and measures necessary for maintain and increase the fertility.

Table 2

The main types and soils associations from west of Romania, ha and % from agricultural surface

Nr.	FAO	TIMIS		ARAD		BIHOR		TOTAL	
		ha	%	ha	%	ha	%	ha	%
1	Leptosol	9833	1.40	6650	1.30	1020	2.04	26683	1,56
2	Regosol	22475	3.20	23581	4.61	13346	2.67	59402	3,47
3	Arenosol	211	0.03	2353	0.46	9936	1.99	12500	0,73
4	Fluvisol	29148	4.15	43684	8.54	53056	10.63	125888	7,35
5	Chernozem	187187	26.65	121857	23.82	87807	17.58	396851	23,16
6	Phaeozem	24722	3.52	33938	6.63	27303	5.47	85963	5,02
7	Rendzinic Leptosol	140	0.02	409	0.08	1118	0.22	1667	0,10
8	Humic Cambisol	-	-	1637	0.32	1911	0.38	3548	0,21
9	Dystric Humic Cambisol	-	-	205	0.04	1257	0.25	1462	0,09
10	Eutric Cambisol	89002	12.67	27212	5.32	4177	0.84	120391	7,2
11	Dystric Cambisol	-	-	7570	1.48	6207	1.24	13777	0,80
12	Haplic Luvisol	85176	12.12	53581	10.48	32862	6.58	171619	10,02
13	Luvisol	76556	10.90	68443	13.38	144255	28.88	289254	16,88
14	Planosol	4214	0.60	6394	1.25	20499	4.10	31107	1,82
15	Cambic Podzol	-	-	153	0.03	1413	0.28	1566	0,09
16	Haplic Podzol	-	-	205	0.04	3975	0.80	4180	0,24
17	Vertisol	71218	10.14	60462	11.82	22595	4.53	154275	9,00
18	Gleysoil	43117	6.14	12328	2.41	7433	1.49	62878	3,67
19	Stagnic Luvisol	7375	1.05	4041	0.79	3857	0.77	15273	1,05
20	Solonetz	42473	6.05	23416	4.58	20133	4.03	860022	5,02
21	Histosol	-	-	205	0.04	533	0.11	738	0,04
22	Erodosol	5618	0.80	10588	2.07	25205	5.05	41111	2,42
23	Anthrosol	3933	0.56	2608	0.51	374	0.07	6915	0,40
TOTAL		702398	100.0	511520	100.0	499452	100.0	1713370	100.0

Because the content of nutritive elements from soil is directly connected with soil type, were made both in our country and wide world numerous researches for determinate the complex relations which are establishing between different characteristics of soils. These researches elucidated several reciprocal causalities, being in this way useful in defining of taxonomical categories of soils, both under genetic aspect and fundamental properties reported with their different aspect of productivity and suitability for certain cultivated plants.

Analyzing the way that phosphorous and potassium content influence plants growth, numerous researches demonstrated the existence of a correlative connection between soil content in these elements and the crop, an important role having the native content of parental material in P_2O_5 and K_2O .

Thus, regarding the supplying state of soils with mobile phosphorous and potassium

was observed that it is connected with the various dispositions of parental materials.

Basing on agrochemical mapping, was founded a big proportion of soils with deficiency in mobile phosphorus, under the level 36 ppm P_{AL} (considerate the limit in satisfying requires of cultures plants), respectively: 73,6 % in Arad County, 70,0 % in Bihor County and 59,8 % in Timis County (fig. 1).

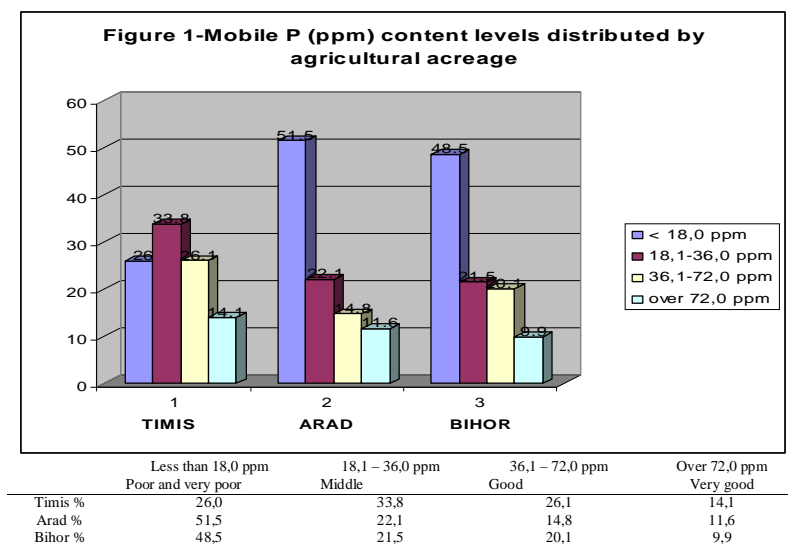


Figure 1 - Mobile P (ppm) content levels distributed in acreage

From all presented data can be observed the existence of a concerning proportion of surfaces with soils very low ad low supplied, respectively 2 fourths in Arad and Bihor Counties and 1 fourth in Timis County. If we talk about deficiency of supplying (under 36 ppm), the situation becomes alarming, over 2 third of studied surfaces being registered in Arad and Bihor Counties and over 2 fourth in Timis County. The explanations for such a fact, consist not only in the agriculture system practiced in the three counties from west of Romania, but rather in the natural particularities of researched territory, with a more significant proportion in the hills and mountains zones from Arad and Bihor Counties, in contrast with plain zones from Timis County, fact that is sustained by the data resulted from the monitoring of state quality of Romanian soils, namely the supplying with phosphorous.

The supplying state with potassium (K_2O) presents values which show a better situation comparing to phosphorous. Data showed that 50 % from researched terrains present a good and very good supplying: 77,63 % in Timis County, 54,70 % in Arad County and 49,0 % in Bihor County (fig. 2).

This situation is the result of pedogenesis processes, the soils from the area evolving in most of cases on the parental material with a significant content in potassium, with a increased value of basic cations. Thus, the soils from subsidiary plain and in great measure from the alluvial plain present a good and very good supply. Not the same thing can be said about soils from the hilly zone, premountainous and mountainous where were identified, since the first cycles of agrochemical mapping, important surfaces occupied by soils low supplied.

An important role in knowing the need and efficiency of fertilizers with phosphorous and potassium in different types of soils and different culture plants had the researches from experimental fields placed in pedoclimatic areas characteristic to the researched space (Gavojdia, Honorici, Salbagelu Nou, Pietroasa, Dumbrava, Masloc, Sanandrei, Aradu Nou, Fantanele, Oradea, Petid, Budureasa etc.) which brought multiple clarifications in this sense.

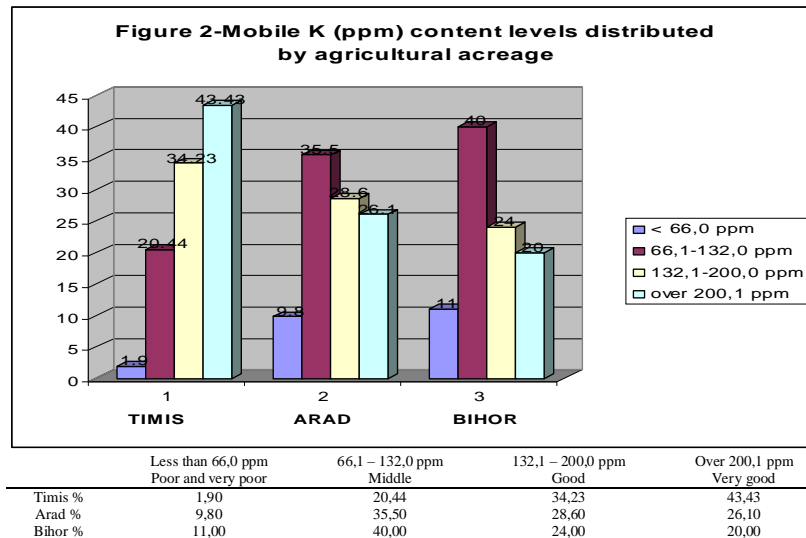


Figure 2 - Mobile K (ppm) content levels distributed in agricultural acreage

A significant role in assuring the mineral nutrition with phosphorous and potassium of plants has the mobility state of these elements in soil. The trials to realize high levels of phosphorous in soils with various pH, demonstrated the impossibility to exceed certain levels of assurance state with mobile P (50-60 ppm), both in acid and in alkaline soils.

Soil reaction, which express in great measure the modalities how are developing the main biochemical processes in soil and the real conditions of plants growth and development, present within the studied area the situations mentioned in the figure 3.

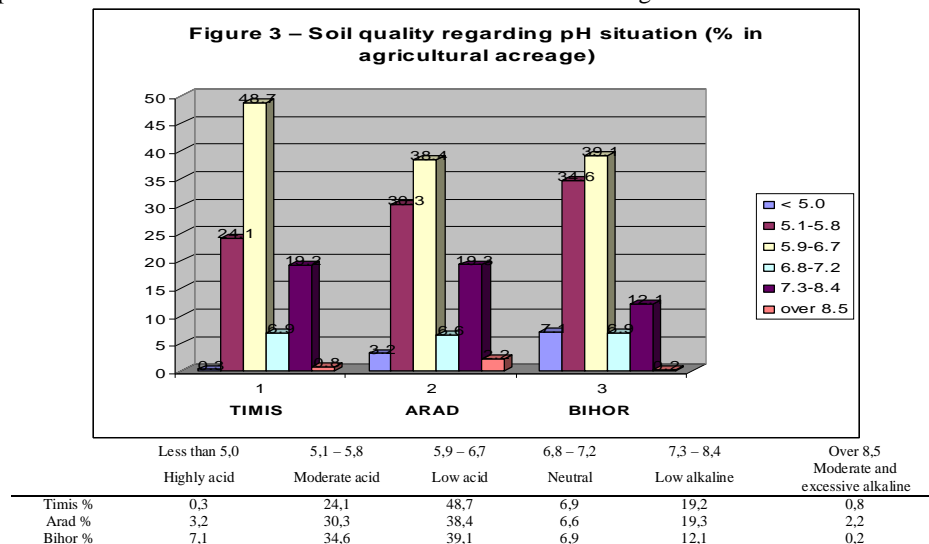


Figure 3 – Soil quality regarding pH situation (% in agricultural acreage)

CONCLUSIONS

Cognition of natural conditions and especially of ecological potential of a certain territory which is defined and characterized in conformity with "Methodology for Elaboration of Pedological Studies (ICPA Bucharest, 1987) presents a significant importance in establishment of management systems of nutrients in the more severe conditions imposed by environment protection.

The physical-geographical conditions specific to the three counties from west part of Romania determined the formation of extremely diverse soils.

The synthesis of pedological and agrochemical mapping effectuated in the area put in evidence a big diversity of supplying levels with phosphorous and potassium (but in equal measure with other nutrients too), supplying determined in great part by the large variability of soil types, as well by the agriculture system practiced in the last decades, without possibility to identify the dependence relation that exists between these and the use of fertilizers and amendments.

To this desiderate respond the best possible the results given by the experience on long term with fertilizers and amendments.

The forecast calculations show that in condition of cessation of supplying with phosphorous and potassium during many years, the decreasing tendencies in these elements could have negative effects in the case of potassium only in the soils with a native deficiency (luvisols, spodosols etc.), and in the case of phosphorous not only in these soils, but in those with a favourable natural potential (calcic and clayey chernozems, mollic preluvosols etc.).

The decline registered in soil supplying with phosphorous and fertilization only with nitrogen, as well as the tendency of applications only of leaf fertilizers without base fertilization, lead to a dramatic decreasing of phosphorous reserves from soil if the completion by fertilization is not made.

OECD (Organization for Economic Cooperation and Development) recommend the supplying of soil with nutritive elements in accordance with planned production, in order to maintain the balance regarding the soil supplying with nutrients.

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