

Soil Resources

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Abstract: In accordance with W.R.B – 2014 „soil is any material within 2 m of the Earth’s surface that is in contact with the atmosphere, excluding living organisms, areas with continuous ice not covered by other material, and water bodies deeper than 2 m. Soils classification in the last international system, WRB – SR (World Reference Base for Soil Resources), ST, Referentiel Pedologique is based on diagnostic features produced by pedogenetic processes. Soil has always been a basic resource for sustaining human populations. Soils served as the planting medium and also provided material for building earthen architectural structures. The evolution of agriculture has a strong imprint on the land in many regions. The vegetation, slopes, valleys, and soil cover were radically altered. The research is based on the soil survey and site evaluation, realized in the last 30 years. From the list of Reference Soil Group, it can be seen that there are 32 Soil Groups with a total area of 150205 billion ha. Maximum fertility occurs in Chernozem (table 2), Kastanozem and Phaeozem, but we can add also Fluvisols, with a total area of 1,115 billion ha. Is necessary to underlining that these soils must be irrigate in droughty years. In accordance with the Romanian Taxonomic Soil System, there are 29 soil types, which occupied 23.660 mill.ha. The best types of soils are distributed on 24.3 % from Romanian area. In the west of Romania Chernozems and Phaeozems occupy 24.08%. In the present, soil degradation and pollution is a great problem for humanity, because 1.965 billion ha are degraded.

Keywords: soil, resources, degradation, food, improvement

1. INTRODUCTION

Soils can be defined as four dimensional natural bodies, where the lithosphere, the atmosphere, the hydrosphere and the biosphere are interlinked.

There is a set of properties which differentiate the soils among each other. Many soils are differentiated in the first instance by their color: humus forming dark to black horizons (Chernozems), iron oxide (FeOOH) yellow to brown colours (Cambisols) and Fe₂O₃ leading to red colours (Ferralsols).

Soil is formed by mineral and organic constituents and they are organized in structures like the anatomy of a living being. In accordance with W.R.B – 2014 „soil is any material within 2 m of the Earth’s surface that is in contact with the atmosphere, excluding living organisms, areas with continuous ice

not covered by other material, and water bodies deeper than 2 m. [11]

The definition includes continuous rock, paved urban soils, soils of industrial areas, cave soils as well as subaqueous soils.

Given the great diversity of soils in different countries, national soil classification systems are justified at the lower categorical levels. As a rule, soils classification in the last international system, WRB – SR (World Reference Base for Soil Resources), ST (Soil Taxonomy), Referentiel Pedologique is based on diagnostic features produced by pedogenetic processes. WRB is a tool for identifying pedological structures. It serves as a basic language in soil science.

Soils, even though there is an awareness that they may be different, they are often dealt with as if they were the same.

Soil has always been a basic resource for sustaining human populations. Soils served as the planting medium and also provided material for building earthen architectural structures and for making pottery.

In many countries we find disturbing examples of once – thriving regions reduced to desolation by human – induced degradation.

The poor condition of the Fertile Crescent today is due in large part to the prolonged exploitation of this fragile environment by generations of forest exploitation of this fragile environment by generations of forest cutters and burners, grazers, cultivators, irrigators, or to the devastation caused by repeated wars.

It is rather ironic that we should have assigned our species so arrogant a name as Homo sapien sapiens.

The evolution of agriculture has a strong imprint on the land in many regions.

The vegetation, slopes, valleys, and soil cover were radically altered.

Early in history the upland watersheds were deforested.

The resulting erosion was conveyed by the rivers as suspended silt settled on the river beds, and the rivers overflowed, inundated large tracts of land.

Increasingly in the 21st Century there are many threats to soil as a result of our activities within the environment: loss of soil through erosion by wind and water, inundation, contamination with pollutants,

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landslides, loss of organic matter, soil compact through use of heavy machinery, salinization and alkalinization as a result of poorly managed irrigation, and a great loss of soil through sealing [2].

These multitude types of soil degradation take place in the context of a continuous increase of the population, which arrived 7,5 billion.

2. MATERIALS AND METHODS

The research is based on the soil survey and site evaluation, realized in the last 30 years by the soil scientists members of International Society of Soil Science presented in the World Reference Base of Soil Resources and Atlas, for the entire world.

For the Romanian and West Romanian soil resources, source of the data was the scientific researches obtained by the Romanian soil scientist. It must be mentioned that the authors of this papee, members of I.SSS and Romanian National Society of Soil, have participated on the soil survey achieved in our country.

Soil classification systems, like WRB – SR (World Reference Base for Soil Resources), USDA (United States Department of Agriculture), SRTS (Romanian Soil Taxonomy System), offered a clear image of the soil potentiality and production capacity, for the purpose of to meet the needs of all the people with foods. [4]

3. RESULTS AND DISCUSSIONS

In accordance with International soil classification system for naming soils and creating legends for soil maps, the results are presented in the table 1 and table 2 for the world soil resources.

Table 1 - World Soil Resources – 2014, mill. ha [9]

Soil	Area	%	Soil	Area	%
Acrisol	1000	6.66	Leptosol	1655	11.02
Alisol	100	0.66	Lixisol	435	2.90
Andosol	110	0.73	Luvisol	600	4.00
Anthrosol	0.5	-	Nitisol	200	1.33
Arenoso	1300	8.65	Phaeozem	70	0.47
Calcisol	1000	6.66	Planosol	130	0.86
Cambisol	1500	9.99	Plinthosol	60	0.40
Chernozem	230	1.53	Podzol	485	3.23
Cryosol	1800	11.98	Regosol	260	1.73
Durisol		0.03	Retisol	320	2.13
Ferralsol	750	4.99	Solonchak	260	1.73
Fluvisol	350	2.33	Solonetz	135	0.90
Gleysol	720	4.79	Stagnosol	175	1.16
Gypsisol	100	0.66	Technosol		
Histosol	375	2.50	Umbrisol	100	0.66
Kastanozem	465	3.09	Vertisol	335	2.23

Total soils =15.0205 billion ha

Table 2 – World Soil Sustainability for food production

Very favorable (with irrigation):	
-	Chernozem 230 mill ha = 1.53 %
-	Fluvisol 350 mill ha = 2.33 %
-	Kastanozem 465 mill ha = 3.09%
-	Phaeozem 70 mill ha = 0.47%
Total area 1.115 billion ha = 7.42 %	
Favorable (with land improvement):	
-	Cambisol 1500 mill ha = 9.99%
-	Luvisol 600 mill ha = 4.00%
-	Regosol 260 mill ha = 1.73%
-	Retisol 320 mill ha = 2.13%
-	Vertisol 335 mill ha = 2.23%
Total area 3.015 billion ha = 20.08 %	
Total 4.130 billion ha = 27.50 %	

From the list of Reference Soil Group, it can be seen that there are 32 Soil Groups with a total area of 150205 billion ha [9].

The largest area is occupied by Cryosol, but Cryosol comprise soils formed in a permafrost environment. Major areas with Cryosol are found in the Russia Federation (1000 million ha). Most areas of Cryosols in North America and Eurasia are in the natural state and support vegetation for grazing caribou, reindeer and musk oxen.

Another soil group with a large area is Arenosol, which occupied 1300 billion ha. Arenosols comprise deep sandy soils. Vast expanses of deep aeolian sands are in Kalahari Desert, Sahelian region of Africa, Sahara, central and western Australia, lands with annual rainfall of less than 300 mm.

Maximum fertility occurs in Chernozem (table 2), Kastanozem and Phaeozem, but we can add also Fluvisols, with a total area of 1,115 billion ha. It is necessary to underlining that these soils must be irrigate in droughty years.

The total areawhich can be use for agriculture, but with long – term investments, in order to guarantee the vital food for the 7.5 billion people.

On a global scale, only 7.42% are very favorable. Production capacity for Romania is presented in the table 3 and 4.

Table 3 – Romanian Soil Resources – 2017, thousand ha

	Soil type – SRTS (Romanian Soil Taxonomy System)	WRB – SR 2014	Area	%
1	Litosol	Leptosol	85	0.4
2	Regosol	Regosol	930	3.9
3	Psamosol	Arenosol	230	1.0
4	Aluviosol	Fluvisol	2180	9.2
5	Kastanoziom	Kastanozem	205	0.8
6	Cernoziom	Chernozem	4200	17.7
7	Faeoziom	Phaeozem	1265	5.8
8	Rendzina	Leptosol rendzic	640	2.7
9	Nigrosol	Umbrisol	5	-
10	Humosiosol	Umbrisol	10	0.1
11	Eutricambosol	Cambisol	1420	6.0

12	Districambosol	Cambisol	3220	13.5
13	Preluvosol	Luvisol	1180	5.0
14	Luvosol	Luvisol	4875	20.5
15	Planosol	Planosol	5	-
16	Alosol	Alisol	-	-
17	Prepodzol	Podzol	960	4.1
18	Podzol	Podzol	270	1.1
19	Vertisol	Vertisol	270	1.2
20	Pelosol	Vertisol	100	0.4
21	Andosol	Andosol	180	0.7
22	Stagnosol	Stagnosol	100	0.4
23	Gleysol	Gleysol	595	2.5
24	Limnosol	Fluvisol	-	-
25	Solonceac	Solonchak	20	0.1
26	Solonet	Solonetz	180	0.7
27	Histosol	Histosol	265	1.1
28	Antrosol	Anthrosol	240	1.0
29	Tehnosol	Technosol	25	0.1
Total area 23,660 mill. ha				
Total Romania area 23,839.1 mill. ha				

In accordance with the Romanian Taxonomic Soil System (SRTS-2012), there are 29 soil types, which occupied 23.660 mill. ha. [10]. The best types of soils – Chernozems, Kastanozems and Phaeozems which are distributed on 24.3 % from Romanian area, plus Fluvisols, arrives to 7.850 mill. ha, respectively

Table 5 – Soil Resources from West of Romania [7]

	WRB – SR 2014	Bihor		Arad		Timis		Caras Severin		TOTAL	
		ha	%	ha	%	ha	%	ha	%	ha	%
1	Leptosol	10188	2.04	6650	1.30	9834	1.40	27534	6.89	54206	2.57
2	Regosol	13336	2.67	23581	4.61	22477	3.20	13987	3.50	73381	3.47
3	Arenosol	9939	1.99	2353	0.46	211	0.03	200	0.05	12703	0.60
4	Fluvisol	53091	53091	10.63	43684	29150	4.15	28573	7.15	154498	7.31
5	Kastanozem										
6	Chernozem	87804	17.58	121844	23.82	187189	26.65	3517	0.88	4000354	18.95
7	Phaeozem	27320	5.47	33914	6.63	24724	3.52	22379	5.60	108337	5.13
8	Leptosol rendzic	1099	0.22	409	0.08	141	0.02	6754	1.69	8403	0.40
9	Umbrisol	1898	0.38	1637	0.32	-	-	799	0.20	4334	0.21
10	Umbrisol	1249	0.25	205	0.04	-	-	26055	6.52	27509	1.30
11	Cambisol	4195	0.84	27213	5.32	88994	12.67	48194	12.06	168596	7.98
12	Cambisol	6195	1.24	7570	1.48	-	-	40122	10.04	53887	2.55
13	Luvisol	32863	6.58	53607	10.48	85131	12.12	41840	10.47	213441	10.10
14	Luvisol	144241	28.88	68440	13.38	76561	10.90	91033	22.78	380275	18.00
15	Planosol	20477	4.10	6394	1.25	4210	0.60	559	0.14	31644	1.50
16	Alisol										
17	Podzol	1399	0.28	153	0.03	-	-	320	0.08	1872	0.09
18	Podzol	3995	0.80	205	0.04	-	-	799	0.20	4999	0.24
19	Vertisol										
20	Vertisol	22625	4.53	60462	11.82	71223	10.14	9551	2.39	163861	7.75
21	Andosol										
22	Stagnosol	3847	0.77	4041	0.79	7375	1.05	4396	1.10	19659	0.93
23	Gleysol	7442	1.49	12328	2.41	43127	6.14	2917	0.73	65814	3.11
24	Fluvisol										
25	Solonchak										
26	Solonetz	20128	4.03	23428	4.58	42495	6.05	-	-	86051	4.07
27	Histosol	549	0.11	205	0.04	-	-	240	0.06	994	0.05
28	Anthrosol	25322	5.07	11588	2.27	7619	1.09	27834	6.96	72363	3.42
29	Technosol	250	0.05	1609	0.31	1933	0.27	2017	0.51	5809	0.27

33.5 %.

Table 4 – Romanian soil sustainability for food production

Very favorable (with irrigation):	
-	Chernozem 4200 thousand ha = 17.7 %
-	Kastanozem 205 thousand ha = 0.8 %
-	Phaeozem 1265 thousand ha = 5.8 %
-	Fluvisol 2180 thousand ha = 9.2 %
Total area 7.850 mill. ha = 33.5 %	
Favorable (with land improvement):	
-	Leptosol rendzic 640 thousand ha = 2.7 %
-	Cambisol 1420 thousand ha = 6.0 %
-	Luvosol 6055 thousand ha = 29.5 %
-	Vertisol 370 thousand ha = 1.6 %
-	Regosol 930 thousand ha = 3.9 %
Total area 9.415 mill ha = 39.7 %	
Total 4.130 billion ha = 27.50 %	

This should be sufficiently for our people and for export, but this demands a hard work and a good management.

In the west of Romania (table 5 and 6) there are similar conditions as in the whole county. Chernozems and Phaeozems occupy 24.08%, and with Fluvisols 31.39%.

Table 6 – West Romanian territory – Soil Resources, ha

Very favorable (with irrigation):	
-	Chernozem 400.354 - 18.95 %
-	Phaeozem 108.337 – 5.13 %
-	Fluvisol 154.498 - 7.31 %
Total area 663.189 - 31.39 %	
Favorable (with land improvement):	
-	Leptosol rendzic 8.403 - 0.40 %
-	Cambisol 68.596 – 7.98 %
-	Luvosol 596.716 - 28.10 %
-	Vertisol 163.861 - 7.75 %
-	Regosol 73.381 - 3.47 %
Total area 907.957 - 47.70 %	

In the present, soil degradation and pollution is a great problem for humanity (table 7), because 1.965 billion ha are degraded [6].

Table 7 – World anthropic soil degradation, million ha [3]

Continent	Water erosion		Wind erosion	
	ha	%	ha	%
Africa	227	7.7	186	6.3
Asia	441	10.1	222	5.1
South America	123	7.0	42	2.4
Central America	46	43.4	5	4.7
North America	60	30	35	1.7
Europa	114	11.1	42	4.1
Ocenia	83	9.8	16	1.9
Total	1094	8.4	548	4.2
Continent	Chemical degradation		Physical degradation	
	ha	%	ha	%
Africa	62	2.1	19	0.13
Asia	74	1.7	12	0.05
South America	70	4.0	8	0.17
Central America	7	5.7	5	4.72
North America	-	-	1	0.05
Europa	26	2.5	36	1.65
Ocenia	1	0.1	2	0.24
Total	240	1.8	83	0.6
Total area degraded: 1,965 billion ha				

In addition, the development of the city consumes for construction of roads, buildings, each day a total area in Europe of 250 ha.

Today 2.3% of the European Union is sealed an equivalent of 200 m² per citizen (Burghardt, 2011).

As more than 50 % of the World population lives in urban areas.

In technosols more than 20% of the volume in a soil profile consists of technic materials, and organic and inorganic contaminants [5]

A very rough estimate of daily soil losses due to sealing on a global scale amounts to about 250 to 300 km² (Blum, 2013) which means an area of about 100000 km². A great number of studies showed a

worldwide increase in urban area of 58000 km² from 1970 to 2000 (Seto, 2011)

For Romania , the extension of degradation affects 61.8 % from the total area of the country (table 8):

Table 8 – Anthropic degradation in Romania [1]

Degradation	Thousand ha	% from total area of Romania
Water erosion	4331	18.2
Wind erosion	387	1.6
Physical degradation	7100	29.8
Chemical degradation	1241	5.2
Complex degradation	614	2.6
Soil excavation and soil cover with waste	33	0.1
Sealing	1022	4.3
Total	14728	61.8

Land resources are affected also by water deficit – 3900 mill. ha, or temporary water – logging – 0.9 mill. ha.

4. CONCLUSIONS

Soil survey must offers informations about the soil cover, the extension of the soil type of an area, and the production capacity, respectively the fertility.

In accordance with WRB – SR – 2014, soil is an epiderma of the Earth's surface. Soil classification is based on diagnostic features and horizon properties.

Total areas with soils in the world are 15,0205 billion ha, but only 7.42% are very favorable in order to assure the food for the 7.5 billion people.

In Romania, total area is 23,660 mill. ha, but very favorable are 33.5%, enough for the 20 mill. people.

Total areas degraded on the world are 1,965 billion ha, and in Romania 14,728 mill. ha.

It is necessary to control the soil evolution and to minimize the pollution.

REFERENCES

- [1] N., Florea, *Degradarea, protectia ;I ameliorarea solurilor si terenurilor*, Ed. Bucuresti, 2003;
- [2] S., Huber, G., *Prokop, Catena Verlag, Geo Ecology Essays, 2015, pg 55-61;*
- [3] R., Lal, *Soil Erosion, Catena Verlag, Geo Ecology Essays, 2015, pg 39-49;*
- [4] Gh., Rogobete, A. *Grozav, Stiinta Solului, Edit. Politehnica, Timisoara, 2016;*
- [5] K., Stahr, *Soils of the World, Catena Verlag, Geo Ecology Essays, 2015, pg 4-8;*
- [6] M., Swift, *Soil system and society, 16 th World Congress Soil Science, Montpellier, 1998, pg 57-74;*
- [7] D., Tărau, Gh., Rogobete, D., Dicu, *Solurile din Vestul României, Editura Eurobit, Timisoara, 2016;*
- [8] *** *Land evaluation, Agr. Publ, nr 7, Brussels, 3 vol;*
- [9] *** *World Reference Base for Soil Resources – Atlas, 1998, I.SSS Working Group R.B., ISRIC – FAO – ISSS – Acco. Leurven;*
- [10] *** *Sistemul Român de Taxonomie a Solurilor - SRTS 2012, Editura SITECH, Craiova;*
- [11] *** *World reference base for soil resources, 2014, Food and Agriculture Organization of the United Nations;*