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STUDY ON CHEMICAL ANALYSIS OF SOIL IN THE COUNTY OF GORJ, IN TERMS OF THE CONTENT OF HEAVY METALS AND CHLORIDES

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Abstract

The soil is the most complex environmental factor, but also the most important in ensuring existential and material support evolving generations of plants, animals and humans, succeeding in time. Gorj county shows the variability of the natural and thus a highly diversified soil cover. The main sources of soil pollution in the Gorj county are mining, energy and oil industry, sources that radically alter the physical indicators of soil quality and pollute with significant quantities of dust, oxides acids, polycyclic aromatic hydrocarbons, chlorides and heavy metals. To highlight the chemical pollution of the soil, samples were collected from representative areas of Gorj county and they were analysed in terms of heavy metals content, by atomic absorption spectrometry. Also, it was made a correlation between pH and chloride content which aimed soil characterization in terms of salinity. Concentrations obtained were compared with normal values and alert thresholds. Study demonstrates that they were recorded exceeding the normal values for heavy metals analysed in some areas of the county, without exceeding the alert thresholds. The pH indicated neutrality soils and in terms of salinity, these are weak saline or moderately saline. In Gorj county it is necessary to apply a strategy to increase the capitalization of potential soil.

Key words*: soil, pollution, heavy metals, chlorides.*

INTRODUCTION

Last year were celebrated 43 years from the famous United Nations Conference in Stockholm on the Human Environment**,** having met in 1972 and considered the historic moment of the general consciousness awakening, by launching the alarm signal „we have a single Earth and have to preserve it” *(Hera, 2014).*

The researches show that from the global share of the land, which is 29%, only 6.4% represents suitable soil for farming and: *the global food production of any kind is about 4.6 billion tones and 2.3 billion tons of edible dried matter; of this total, 98% is produced in earth and less of 2% is from the oceans and from freshwaters; the vegetable products represent 92%of human diet; about 30 of cultivated species provide the majority of the calories and proteins in the world, 8 cereal species providing 69% of food sources; the animal products concur with 8% at the humanity diet, but these are circumlocutory from plants, too (Toncea et al.)*

In this respect, it is widely appreciated the fact that, of the essential resources of life on Earth, the soil disputes the supremacy with the water resources, air and biodiversity, with which cooperates, ensuring the evolving and existential material support for the plant, animal and human generations, to succeed in time. The soil is formed through a slow process of natural transformations, which lead for a millennium at the forming of a 3 cm layer, for 20 cm tilth (the minimum layer necessary to develop a plant) being required up to 7000 years.

The landscape non-uniformity of the Gorj County created a very diversified soil cover, in the county being identified 9 classes of soil, which include 15 types of soil (www.recolta.eu) (Figure 1).

The soil types in the Gorj County and the occupied surfaces are shown in Table 1.

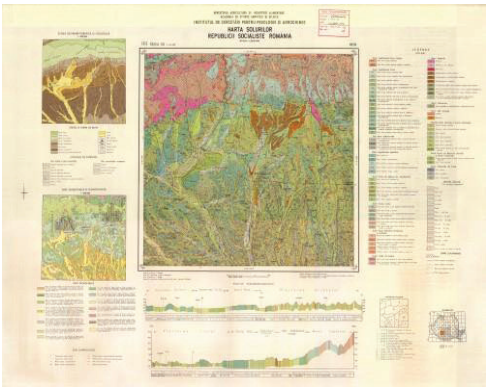

Figure 1. Gorj county soil map

Table 1.Soil distribution by type of use

Soil category	Surface (ha)
Arable land	98 239
Pastures	87 212
Meadow	41 685
Vine	4 191
Orchards	7 473
Total agricultural land	238 800

In Gorj county, the soil environmental factor is mainly wasted because of natural polluting sources, but of anthropic sources, too. Among these, the most important are:
- the mining indutry, which is based on glory-hole of the lignite in the mining fields of Rovinari, Jilt, Rosia, Motru and has an effect upon 13000ha, resulting huge surfaces of technogene soils, deprived them of basic property, the fertility;
- the power industry, is based on obtaining of electricity in two big thermo electrical power plants Rovinari and Turceni, and pollute the soil with SOx, NOx, COx, heavy metals and important quantities of ash and breeze, having an effect upon 250 soil ha;
- the petroleum industry, which has a chemical effect upon about 1000 ha from Ticleni, Stoina area, by polluting with multi-ring hydrocarbons, hydrochlorides and salt water;
- stock raising industry, which pollutes the soil with livestock wastes and residues, due to the hennery activities (in the society SC AVI INSTANT SRL, Farm no. 2 and 3 from Danesti township, Farm no. 4 from Preajba village), the growth and the operation of the laying hens (in SC ASSANI IMPEX SRL, Branesti township), the growth and the operation of the pigs (in the societies SC SUNIPROD SA and SC FARMASN from Bumbesti-Jiu and Tg-Jiu Penitentiary), the growth and the operation of dairy cows (pilot rehabilitation center for disabled persons from Tg-Carbunesti, Tg-Jiu Penitentiary, SC FERMA MORAGIB SRL from Scoarta township);
- agriculture, by polluting the soils of Balesti area with nitrates due to uncontrolled and excessive use of nitrous chemical fertilizers and pesticides, highlighted by a permanent increase of the herbicide quantities used per hectar;
- the clearings, contribute to the occurence of erosion phenomena (166.099 ha) and to the landslides in furrows, in waves, in steps, with mounds, flowings or crashes (48.406 ha)
In the whole Gorj county, it predominates the acid soils, the nitrogen supply is weak, and the moving phosphorus is very weak.

MATERIALS AND METHODS

To analyse the soil quality in Gorj County, there were collected soil samples from representative areas of the county, potentially polluted with heavy metals and chlorides. The collection was performed using the pedologic probe, in depth levels of 0-10 cm and 10-20 cm (Popa et al., 2011). The collection points are the following:
- Targu Carbunesti (town entrance);
- Scoarta (crossroads);
- Dragoieni (across the Agrochemical and Soil Survey Register);
- TarguJiu (city beltway, Margaritarului street, Meteor street – Meteo Station);
- Rovinari (Vart – 2000 m N of thermo electrical power plant, Rogojelu II – 300 m V of thermo electrical power plant, convey belt area – 1000 m SV of thermo electrical power plant, drilling neighborhood – 1500 m S of thermo electrical power plant, bridge Moi – 800 m SE of thermo electrical power plant);
-Rovinari – from the Cicani-Beterega ash deposit (5m N1 slope of the deposit, 5m N2 slope of the deposit, 5m V1 slope of the deposit, 5m V2 slope of the deposit);
- Motru (from the neighborhood of the Rosiuta deposit, from Rosiuta – Osnaga family, from 200 m V and 400 m S of the U.A.T.A.A.);
-Ticleni (from the injection station, Turbo A area, Park no. 14 and the Big Park);

-Turceni (from 200 m V of the thermo electrical power plant – to the right by the bridge , 800 m V of the thermo electrical power plant – way to Ionesti, 500 m E of the thermo electrical power plant – by PECO, 700 m S of the thermo electrical power plant – after Cursaru, to the right);
- Coltesti – Hurezani (gauge board Hurezani, affected area, Madalan Ana family, Vadulescu family).
The soil samples were transported in the laboratory and were analysed for heavy metal content: Cu, Pb, Zn, Cd and As, using the atomic absorption spectrometry, in flame variant method (Stoica et al., 1986).
The obtained concentrations were compared to the normal values and to the threshold of alert, for each heavy metal, in accordance with the law (Order 756/97) (Table 2).

Table 2. Normal value and thresholds for heavy metals indicators

Chemical indicator of quality - heavy metal	Normal value (VN) [mg/kg dry substance]	Thresholds (PA) [mg/kg dry substance]
Cu	20	100
Pb	20	50
Zn	100	300
Cd	1	3
As	5	25

The samples pH was analysed using the automatic pH-meter and the degree of salinity, for all sampling points and the depth levels in which there have been analysed the heavy metals (Popa et al., 2011).
The chlorides were determined using the volumetric method, after Mohr.

RESULTS AND DISCUSSIONS

After analysis and comparison of the obtained concentrations with the normal values and with the alert threshold, the followings were resulted:
- there were recorded overruns of VN, without overrunning PA, for the Cu, Pb, Zn, Cd indicators in the following sample points:
- the Cu indicator in Targu Carbunesti area (at the entrance in town, on both depth levels), Scoarta area (in the crossroad, on both depth levels), in Targu Jiu area (at beltway level -2m and 10 m distance of DN67, in the Margaritarului street and Meteor street - Meteo Station, on both depth levels);
- the Pb indicator in Dragoieni area (across OSPA, at 5 m distance of DN67, on both depth levels), in TgJiu area (in Margaritarului street and Meteor street - Meteo Station, on both depth levels);
- the Zn indicator in Targu Jiu area (at the city beltway, at 2 m distance of DN67, on the depth of 10-20 cm, but, also, at the depth of 10 m of DN67, at both depth levels);
- the Cd indicator (in Targu Jiu area, at the city beltway level, at 10 m distance of DN67, at depth of 0-10 cm, in Rovinari area);
- theAs indicator (in Rovinari area);
- the threshold of alert was overran only for the Pb indicator, in Targu Jiu area, Margaritarului street.
Concentrations of heavy metals determined in soil samples harvested from representative contaminated areas on two levels deep 0-10 cm and 10-20 cm, are shown in tabular: chemical analysis of heavy metals in soil samples from the area Targu Carbunesti, Scoarta, Dragoieni and Targu Jiu (Table 3), Rovinari and deposit Cicani Beterega - Rovinari (Table 4), Motru and Ticleni (Table 5), Turceni and Coltesti Hurezani (Table 6).

Table 3. Chemical analysis of heavy metals in soil samples from the area Targu Carbunesti, Scoarta, Dragoieni, Targu Jiu

Area	Sampling point	Profile depth (cm)	Quality indicator (heavy metal) [mg/kg dry substance]			
			Cu	Pb	Zn	Cd
Târgu Cărbunești	imput city	0-10	**67.5**	11	44.2	0
		10-20	**78.1**	6	42.8	0.6
Scoarta	intersection	0-10	**74.6**	10	46.8	0.2
		10-20	**63.9**	6	60	0
Drăgoieni	5m distance DN67, opposite Office of Soil Survey and Agrochemicals	0-10	15,2	**26,6**	88,2	0,8
		10-20	13	**41,2**	76,8	0,4
	10m distance DN67, opposite Office of Soil Survey and Agrochemicals	0-10	13,6	3,8	59,6	0,6
		10-20	14,2	3,0	77	0,2
Târgu Jiu	Belt city, 2m distance DN67	0-10	**63,9**	9	69,4	0,2
		10-20	**67,5**	1	**178**	1
	Belt city, 10m distance DN67	0-10	**74,6**	15	**106**	**1,4**
		10-20	**71**	16,4	**101**	0,8
	Street Mărgăritarului	0-10	**72.6**	**64.0**	38.2	0.6
		10-20	**54.6**	**38.0**	40.0	0.4
	Street Meteor, Meteorological station	0-10	**21.6**	**22.0**	98.2	0.2
		10-20	**26.4**	**20.4**	82.2	0.2

Table 4. Chemical analysis of heavy metals in soil samples from the area Rovinari

Area	Sampling point	Profile depth (cm)	Quality indicator (heavy metal) [mg/kg dry substance]				
			Cu	Pb	Zn	Cd	As
Rovinari	Vârt, 2000m N thermoelectric plant	0-10	**20.2**	5.49	60.6	0.4	1.42
		10-20	**21.4**	3.67	72.8	0.2	2.97
	Rogojelu II, 300 m V thermoelectric plant	0-10	**33.8**	4.11	**133.0**	1	**8.31**
		10-20	**36**	11.7	**105.0**	1	**9**
	The conveyors,1000m SV thermoelectric plant	0-10	**40.4**	2.47	**124.6**	**1.6**	**10.85**
		10-20	**36.2**	5.26	**116.2**	1	**10.32**
	Drilling neighborhood, 1500m S thermoelectric plant	0-10	**28.4**	0	60.6	**1.6**	0.59
		10-20	**22**	0	57.6	**1.4**	0.6
	Moi bridge, 800m SE thermoelectric plant	0-10	12.4	0.87	44.4	**1.8**	2.62
		10-20	12.6	0	39.8	**1.6**	0.63
Cicani-Beterega deposit, Rovinari	5m N1 slope deposit	0-10	21.6	8.2	43.6	0	3.45
		10-20	**27.8**	1.2	49.2	0	4.98
	5m N2 slope deposit	0-10	**37.4**	4.2	36.4	0.4	4.4
		10-20	**31.2**	0.0	37.0	0	4.2
	5m V1 slope deposit	0-10	19.8	1.2	40.6	0	2.93
		10-20	10.8	3.8	31.8	0.4	**6.23**
	5m V2 slope deposit	0-10	**24.6**	0.0	57.6	1	**5.35**
		10-20	**20.6**	0.0	52.0	1	**6.67**

Table 5. Chemical analysis of heavy metals in soil samples from the area Motru and Ticleni

Area	Sampling point	Profile depth (cm)	Quality indicator (heavy metal) [mg/kg dry substance]			
			Cu	Pb	Zn	Cd
Motru	warehouse neighborhood Rosiuta	0-10	**39.6**	13.4	58.2	0.2
		10-20	**34.8**	8.4	64.0	0.2
	Rosiuta family Osnaga	0-10	**24.2**	5.6	74.8	0
		10-20	**21.6**	7.4	69.6	0
	200 m V U.A.T.A.A.	0-10	**30.4**	12.2	57.6	0
		10-20	**20.8**	9.8	60.4	0
	400 m S U.A.T.A.A., warehouse neighborhood Rosiuta	0-10	**24.8**	6.4	55.8	0
		10-20	**34.4**	11.8	62.8	0
Ticleni	Department injection	0-10	13.8	0.0	33.2	0
		10-20	10.2	0.0	23.8	0
	AreaTurbo A	0-10	**20.8**	1.2	59.2	1
		10-20	18.8	0.8	47.6	0.8
	Park number 14	0-10	11.2	0.0	49.2	1
		10-20	16.6	0.0	59.0	1.4
	Large Park	0-10	13.2	2.8	41.2	0.8
		10-20	14.8	0.0	42.2	0.4

Table 6. Chemical analysis of heavy metals in soil samples from the area Motru and Ticleni

Area	Sampling point	Profile depth (cm)	Quality indicator (heavy metal) [mg/kg dry substance]				
			Cu	Pb	Zn	Cd	As
Turceni	200m N thermoelectric plant, right near bridge	0-10	**24.2**	19.4	99.6	0.27	2.72
		10-20	**27.4**	**21.4**	**107.2**	0.3	3.49
	800m V thermoelectric plant, road to Ionesti	0-10	15.4	13.4	60.6	0.07	2.91
		10-20	16.8	16.6	67.2	0.07	3.04
	500m E thermoelectric plant, near PECO	0-10	15.4	15.4	57.2	0.01	1.12
		10-20	20.0	16.6	74.4	0.09	1.71
	700m S thermoelectric plant, after Cursani, in the right	0-10	16.4	18.4	53.0	0.04	2.24
		10-20	19.6	19.8	71.4	0.05	1.97
Coltesti-Hurezani	Panel measure Hurezani	0-10	19.6	0.8	47.2	0.2	0.54
		10-20	19.8	3.8	44.4	0.2	1.79
	Affected area	0-10	8.2	2.2	15.4	0	0.55
		10-20	**25.0**	1.4	47.0	0	0.5
	Family Manolache	0-10	**21.0**	0.4	84.8	0.2	0.72
		10-20	**29.8**	0.0	**112.8**	0.4	0.78
	Family Trocan	0-10	**22.2**	0.2	71.0	0	0.69
		10-20	**26.6**	0.2	88.0	0.2	0.74

For all the soil samples collected at the Gorj county level, pH indicates soils with neutral character and achieving a correlation pH and chlorides (in mg Cl/100 g soil) it demonstrated that in the Dragoieni, Targu Jiu, Rovinari, Turceni and Coltesti Hurezani areas, the soil is moderately salinated, in the Targu Carbunesti and Motru areas, the soil is weak salinated, and in the Scoarta area, the soil is desalted.

CONCLUSIONS

The soil disputes the supremacy with the water resources, air and biodiversity, with which cooperates, ensuring the evolving and existential material support for generations, which succeeding in time.

In Gorj County, the soil environmental factor is mainly wasted because of natural polluting sources, but of anthropic sources, too: the mining, power, petroleum industry, stock raising industry, agriculture.

To analyse the soil quality in Gorj County, there were collected soil samples from representative areas of the county, potentially polluted with heavy metals and chlorides, in depth levels of 0-10 cm and 10-20 cm.

They were analysed in terms of heavy metals content, by atomic absorption spectrometry. Also, it was made a correlation between pH and chloride content which aimed soil characterization in terms of salinity.

Concentrations obtained were compared with normal values and alert thresholds.

Study demonstrates that they were recorded exceeding the normal values for heavy metals analysed in some areas of the county, without exceeding the thresholds alert.

The pH indicated neutrality soils and in terms of salinity, these are weak saline or moderately saline.

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