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Original Article

Effect of Uncontrolled Human Intervention on the Main Pedoagrochemical Characteristics of Proxicalcaric Regosoil in the Ţaga Area

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Abstract

This paper presents severe soil degradation through uncontrolled human interventions made by the National Gas Company "Romgaz SA" Mediaş in Transylvania. The rush to profit of this company with minimal costs did not take in account the degradation and destruction of many agricultural areas in the region. At present, in Romania, after 1989, the transition to a market economy, the degradation and destruction of agricultural land and forestry through various forms of pollution and especially byaggressive and uncontrolled human interventions, has reached alarming levels. In this context, the paper aims to treat the Ţaga village, located in the county of Cluj in the Transylvanian Plain, an area which nature has endowed with priceless gifts, that are suitable to sustainable, conservative and profitable agriculture. Since ancient times, the locals of the area where the research was conducted, were busy with farming, fruit growing and livestock, an area characterized by low hills, with flat land, inclined moderately. The area studied is located on carbonate materials (sandstone, marl), with major influence in the formation of the soils in the area

Keywords: fertility, soil, human intervention.

1. Introduction

It is known that soil is the result of the interaction between rock, relief, climate and vegetation formed by the permanent and simultaneous action of the biosphere, atmosphere, hydrosphere, lithosphere but also of the human activity and it is considered a particularly important natural resource just like water and air, as representing the essential support to life on Earth.

The soil, as a result of the interaction of environmental factors on the surface of all the earth's crust, highlights the state of quality of the environment. Despite the advanced technical progress, the man hasn't been detached from the soil yet, but lives and procures nearly all the resources necessary to life only from soil. In this sense, it isvery important to note that as the level of soil degradation increases, respectively removing it from agricultural use, its recovery may require tens and hundreds of years and the costs for insertion into productive agricultural use are enormous.

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Currently the most aggressive threats on soils in Romania are: climate change, loss of organic matter, low content in nutritious elements (nutrients) to feed plants, acidification and eutrophication, heavy metal contamination, soil erosion, pesticide pollution, compacting and dismantle of soil, salinization, which allaccumulated lead to serious losses in biodiversity. The aim of the research is to describe the main pedoagrochemical characteristics of the soil type proxicalcaric regosoil [5], respectively regosoil [2] destined for crops of Ţaga village, located in the low hills of Transylvanian Plain and how the severe degradation of the soil occurs because of uncontrolled human intervention.

The importance, originality and novelty of this research into agricultural land degradation is due to changes taking place in our country, especially with the changing forms of property and agricultural land administration.

In this transition period with an unclear legislation and a generally uncertain status, large companies take advantage and in the pursuit of profit, they disregard the destruction and degradation level of the physical condition of the soil by its excessive compaction and salt water contamination in drilling technological processes they use in exploration of natural gas.

2. Material and Method

The investigation was conducted in Ţaga village, located in the central-western county of Cluj, geographically situated in the Plain of Someş, as part of the Transylvanian Plain.

The figure below illustrates the administrative settlement of the studied parcel, on Google Earth (Fig. 1) and in Photo 1 it is displayed the overall location of the degraded land in the area.

Figure 1. The administrative settlement of the studied parcel [10]

Photo 1. Location of degraded land in the area (overview)

Photo 2. The destruction of land by human activity of The National Natural Gas Company Romgaz S.A. Mediaş

Photo 2 shows the degree of damage to tillable land, available for agricultural production, through aggressive human intervention from The Natural Gas Company Romgaz S.A. Mediaş.

During this research, we performed field measurements, observations and soil sampling at depths of 0-20 cm, 20-40 cm, 40-60 cm, with probe-type pedoagrochemical drills for pedoagrochemical analysis, both from neighboring undisturbed land and the land disturbed by human intervention after the National Gas Company Romgaz S.A. Mediaş to determine the correct soil type and suitability for agriculture which existed initially, before human intervention from Romgaz S.A. Mediaş Society and the soil degradation state of the researched area following the uncontrolled human intervention of the Romgaz S.A. Mediaş Company.

The researches and observations were based on studying and describing the pedoagrochemical characteristics of the two soils (undisturbed and disturbed), on conducting field and laboratory analysis, on the assessment of the condition of soil fertility and suitability for agriculture and horticulture.

Pedoagrochemical soil analysis were performed using the ICPA methodology for the agrochemical laboratories "Methodology of soil agrochemical analysis in order to establish the amendments and fertilizers necessary " ICPA 1981, and description of soil profile according to SRTS, 2012 [5], SRTS, 2003 [4] and SRCS, 1980 [3], establishing the degree of soil degradation by evaluation sheets.

3. Results and Discussions

The measurements and findings made on the spot revealed that the land is located outside Ţaga village, Cluj County, in the Lake Taga field area, with a geometric shape as a regular quadrilater and it is located on a short slope, with a slight inclination between the access road and the lake, being an arable farmland, suitable for most field crops (wheat, barley, oat, corn grain, corn silage, sugar beet, clover, vegetables, potatoes, soybeans, rye), vegetable crops in the field and fruit shrubs.The results of field and labaoratory pedoagrochemical analysis revealed major changes in the quality of the soil disturbed by aggressive human intervention downgrading the soil from class II of quality, prior to human intervention, to the quality grade IV, after human intervention, respectively fromproxicalcaric regosoil (undisturbed natural ground) to erodic antrosoil (soil disturbed by aggressive anthropogenic intervention). As a result of the high level of soil degradation, soil fertility and the main quality features decreased sharply, negatively influencing the level of agricultural and horticultural crops from the perimeter affected by the aggressive anthropogenic intervention. **Pedoagrochemical characterization of natural undisturbed soil** – Proxicalcaric Regosol (Photo 3 and Table 1): the proxicalcaric regosoilt identified in the undisturbed land, belongs to the order of undeveloped or poorly evolved soils, respectively Entisoils. Evaluation grades decrease, but without severe penalties because of the slope, moderate humus content and useful edafic volume (Table 2).

Photo 3. The land anthropogenic unaffected by Romgaz S.A. Mediaş Company

Table 1. Proxicalcaric Regosoil - Undisturbed Natural Soil

Horizons	Ao	A / C	Ck_1	Ck_2
Depth (cm)	0- 20	20-40	40-60	80-100
The depth of the sample harvesting (cm)	5-15	25-35	45-55	85-95
Particle size analysis				
Coarse sand (2.0-0.2mm)%	4.54	1.74	3.52	0.85
Fine sand (0.2-0.02mm)%	35.69	34.04	45.65	39.26
Dust I (0.02-0.05mm)%	9.74	9.34	5.81	8.36
Dust II(0.05-0.002mm) %	17.08	14.87	13.22	16.55
Physical clay (<0.002mm)%	32.95	40.01	31.80	34.98
Texture Interpretation	LL / 42	TT / 52	LL / 42	TT / 52
Skeleton%	-	-	-	
Physical analysis				
Hygroscopicity, %	4.25	3.75	5.96	5.13
Apparent density, g/cm^3	1.16	1.15	1.26	1.33
The total porosity, %	58	57	53	51
Iinterpretation	Extremely high	Very high	High	Moderately high
The degree of compaction, % v/v	-16.00	-11.76	-6	0
Interpretation	Loose	Loose	Untapped	Untapped
Chemical analysis				
pH	7.35	7.90	8.10	8.60
Interpretation	Weak alkaline	Weak alkaline	Moderately alkaline	Moderately alkaline
Carbonates%	4.4	9.2	10.40	18.80
Interpretation		Middle	Middle	Great
Humus%	2.80	2.10	1.76	
Interpretation	Little	Little	Little	
Humus reserve	65	43	22	
N Total%	0115	0101	0080	
Interpretation	Little	Little	Very small	
P Mobile (ppm)	9	8	4	
Interpretation	Very small	Very small	Very small	
K Mobile (ppm)	152	34	11	
Interpretation	Middle	Extremely small	Extremely small	
Vah%	100	100	100	100
Interpretation	Eubasic	Eubasic	Eubasic	Eubasic

Table 2. Evaluation for natural soil, undisturbed, Location: Ţaga village, outside Ţaga village, Cluj County. The geographical coordinates of the profile: $47^0$18'08"N,$22^0$24'40' E. Natural undisturbed land in the vicinity of the anthropogenic affected one.

Nr. Ind.	Indicator	Code ind.	Framing limits	Coefficients of evaluation Arable			
				GR	OR	PB	SF
3C	Tmax (corrected)	10.5	10.1 - 11.0^{0}C	1	1	1	1
4C	Pma (corrected)	0575	571-600 mm	1	1	1	1
14	Gleyzation	0	Absent	1	1	1	1
15	Pseudogleyzation	0	Absent	1	1	1	1
16	Salinisation / alkalizing	0	Abs	1	1	1	1
23A	Texture (0-20cm)	42	L L	1	1	1	1
33	Incline	07	5-10%	1	1	0.9	0.9
38	Slips	0	Abs	1	1	1	1
39	Groundwater	3.5	3-5 m	1	1	1	1
40	Flooding	0	Abs	1	1	1	1
44	The total porosity	-5	0 ... -10	1	1	1	1
61	$CaCO_3$	10	9-12	1	1	1	1
63	The reaction (0-20cm)	8.1	7.9-8.1	1	1	1	1
133	EdaficVolume	088	76-100%	1	1	0.9	1
144	Humus reserve	090	61-120 t/ha	0.8	0.8	0.8	0.7
181	Excess moisture.	1	Absent	1	1	1	1
The product of the coefficients of evaluation				0.8	0.8	0.648	0.63
Note of evaluation				80	80	69	63
Average grade of evaluation				73			
Quality class				II			

Abbreviations: GR = wheat, OR = barley, PB = corn, SF = sugar beet.

Pedoagrochemical description of anthropogenically disturbed soil - Erodic Antrosol (Photo 4 and Table 3, Table 4): the rodic antrosoil identified in the anthropic disturbed perimeter resulted from man-made transformations due to aggressive interventions with heavy machinery of The National Gas Company Romgaz SA Mediaş in the area.

Table 3. Erodic Antrosol - soil influenced by human activities

Horizons	A / C	Ck_1	Ck_2
Depth (cm)	0- 20	20-40	40-60
The depth of the sample harvesting (cm)	5-15	25-35	45-55
Particle size analysis			
Coarse sand (2,0-0,2mm)%	1.74	3.52	0.85
Fine sand (0.2-0.02mm)%	34.04	45.65	39.26
Dust I (0.02-0.05mm)%	9.34	5.81	8.36
Dust II (0.05-0.002mm)%	14.87	13.22	16.55
Physical clay (<0.002mm)%	40.01	31.80	34.98
Interpretation texture	TT / 52	LL / 42	TT / 52
Physical analysis			
Hygroscopicity%	3.75	5.96	5.13
Apparent density g/cm ^{3}	1.52	1.46	1.33
The total porosity%	44	46	51
The interpretation	Mica	Great	Middleweight
The degree of compaction% v/v	+15.38	8	0
Interpretation	Moderate tapped	Poor Tapped	Ñetas
Chemical analysis			
pH	7.90	8.10	8.60
Interpretation	Weak alkaline	Moderate alkaline	Moderate alkaline
Carbonates%	9.2	10.40	18.80
Interpretation	Middle	Middle	Great
Humus%	1.10	0.76	
Interpretation	Little	Little	
50 cm humus reserve	33	22	
N Total%	0101	0080	
Interpretation	Little	Very small	
P Mobile (ppm)	8	4	
Interpretation	Very small	Very small	
K Mobile (ppm)	34	11	
Interpretation	Extremely small	Extremely small	
Vah%	100	100	100
Interpretation	Eubasic	Eubasic	Eubasic

Table 4. Evaluation for soil disturbed by anthropogenic activities of The Natural Gas Company Romgaz S.A. Mediaş, Location: Ţaga village, outside Ţaga village, Cluj County. The geographical coordinates of the profile: $47^0$18'08"N, $22^0$24'40"E. Land degraded by the influence of human activities from The Natural Gas Company Romgaz SA Mediaş, in the vicinity of the unaffected land.

Nr. Ind.	Indicator	Code ind.	Limits Framing	Coefficients of evaluation, Arable			
				GR	OR	PB	SF
3C	Tmax (corrected)	10.5	10.1 - 11.0^0 C	1	1	1	1
4C	Pma (corrected)	0575	571-600 mm	1	1	1	1
14	Gleyzation	0	Absent	1	1	1	1
15	Pseudogleyzation	0	Absent	1	1	1	1
16	Salinisation / alkalizing	0	Abs	1	1	1	1
23A	Texture (0-20cm)	52	L A	1	1	1	1
33	Incline	07	5-10%	1	1	0.9	0.9
38	Slips	0	Abs	1	1	1	1
39	Ad.Groundwater	3.5	3-5 m	1	1	1	1
40	Flooding	0	Abs	1	1	1	1
44	The total porosity	25	> 25	0.8	0.8	0.8	0.8
61	$CaCO_3$	18	16.-20	1	1	1	1
63	The reaction (0-20cm)	6.1	5.5-6,4	0.9	0.9	0.9	0.9
133	Edafic Volume	063	51-75%	0.8	0.8	0.7	0.8
144	Humus reserve	045	31-60 t / ha	0.6	0.6	0.5	0.4
181	Excess moisture.	1	Absent	1	1	1	1
The product of the coefficients of evaluation				0.3456	0.3456	0.2268	0.207
Note of evaluation				35	35	27	21
Average grade of evaluation				29.5			
Quality class				IV			

Abbreviations: GR = wheat, OR =barley, PB = corn, SF = sugar beet.

Compared to theundisturbed land, respectively proxicalcaric regosoil, from the vicinity of the perimeter that is affected by the aggressive anthropogenic interventions, respectively erodic antrosoil, the following effects were found: due to the uncovering of the shallow horizon, primarily, the useful edafic volume of the soil decresed from 88 to 63%; simultanious with the uncovering of the fertile top soil layer from the surface,a strong compaction of the upper horizons of soil took place, the compaction degree increased from -16 to +15 in the first 20 cm, respectively from -11 to +8 on the depth of 40-60 cm.

Calculating the degree of compaction (GT) was done using the formula:

$$GT = \frac{PMN - PT}{PMN} \ 100$$

$$PMN = 45 + 0.163A$$

Where: PMN - minimal porosity necessary% v/v; PT - total porosity% v/v; A - clay content%.

With the increase of the degree of compaction, the total porosity of the soil decreased from 58% v/v to 44% v/v in the arable layer, considerably worsening the airohydric regime of the soil.

Even though the percentage of apparent humus did not suffer major declines in the first horizons, this was due primarily to the increase of the apparent density by compacting the soil.

But applying the formula for calculating the reserve humus (humus reserve = Σ HUM x h x Da) it can easily seen the decrease of the reserve from 129 t / ha to 55 t / ha. At the same time with the uncovering of the fertile soil layer, was lost an important reserve of organic matter and and also the main plant nutrients, especially for potassium.

Decreasing the edafic volume through uncovering it becomes obvious that the lower, heavily carbonated layers have reached a critical depth, reducing considerably the range of crops. The issue is especially susceptible to mobile iron insufficiency, accessible from the soil solution, occurring phenomenon of iron deficiency also known as the "ferric chlorosis" or "ferrocalcic chlorosis" seriously affecting plant metabolism.

Through the loss of the superficial horizon, practically the clayey texture disappeared, preferred by the majority of plants, and reached the surface, the lower horizon with clay loam texture, with a higher percentage of clay, this way increasing the resistance of soil to plowing or other mechanical works that are specific to the culture technology of the cultivated plant species.

All these major changes were due to uncontrolled human activity which had the effect of a drastic fall of the evaluation sheet grades from 73 points to 29.5 points, for agricultural use, this soil type going practically from class II, quality class to class IV quality class, situation reflected in the two sheets of evaluation, in the same conditions of relief and climate, but with substantial changes in terms of physical and agrochemical characteristics of the investigated soil.

4. Conclusions

The obtained results can highlight the following issues related to the destruction of the main characteristics of the soil quality of the land area located outside the Ţaga village, Cluj County by uncontrolled human intervention from the Natural Gas Company Romgaz SA Mediaş:

Evaluation notes significantly decrease from quality class II, for the control soil, proxicalcaric regosoil, natural, undisturbed by anthropogenic influences to quality class IV, in soil category of erodic antrosoil affected by anthropogenic influences of Natural Gas Company Romgaz SA Mediaş, due to erosion occurred as a result of interventions with equipment, of the destruction of the fertile layer in the superficial horizon A_0 of soil and strong salinization of soil by uysing probably some chemical substances (soluble salts) which involves a complex of measures of agrochemical improvement;

Following these severe human interventions, the fertile soil layer at the depth (0-25 cm) was removed, no longer existing a clear delimition of the horizons on the soil profile with major consequences on the characteristics of fertility, soil quality and suitability for crop production.

Removal of the fertile layer of soil has drastically reduced the organic matter content (humus in the soil) in the soil, considered to be the most important natural resource of plant nutrients.

In such conditions it was severely reduced the soil edafic volume and through compaction decreased the total porosity, thus affecting soil airohydric regime and severely worsening the pedoagrochemical characteristics, requiring complexe ecological restoration measures for its reinstatement in the agricultural circuit;

As a result of various forms of pollution, degradation and destruction in a growing rhythm of the soil cover, measures should be taken to extend the sustainable use for agricultural and horticultural

lands, which to prevent or reduce soil degradation, to restore the productive capacity and vital processes of these degraded arable soils

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