



Original Article

Rehabilitation of the Agricultural Lands Degraded by Uncontrolled Human Intervention in Transylvania

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Abstract

This paper presents the rehabilitation of some of the lands degraded by uncontrolled human interventions conducted by the National Gas Company Romgaz SA Media , in Transylvania. Severe soil degradation by loss of the fertile horizon at the surface, powerful compaction by operating heavy machinery, soil pollution with different substances used in natural gas extraction technology have led to the removal of the affected area from the agricultural use over a long period of time. This negative process of aggressive human activities on soil, as was previously shown, occurs frequently on arable soils in Romania, so the degradation and destruction of agricultural and forestry lands through various forms of pollution, especially by uncontrolled human intervention, has reached alarming levels. The rush to profit of this company with minimal expenses, disregarded the degradation and destruction of many agricultural lands in the area, with serious consequences on the physical, chemical and biological status of the soil and even on biodiversity. Ecological recovery and the restoration of the fertility of these soils to the one that was before the human intervention from Romgaz S.A. Media Company, requires a comprehensive approach leading to elimination of excess moisture combined with land improvement works to improve soil reaction through amendments, periodic organic and mineral fertilization for raising the productive potential of degraded soils and introducing them back into agricultural use. In this context, the paper aims to deal the rehabilitation of agricultural land located in the unincorporated area of aga village, Cluj County in the Transylvanian Plain, an area characterized by low hills, flat and moderately sloped land that lends itself to a conservative sustainable and profitable agriculture. Pedologically, the studied area is located on carbonate materials (sandstone, marl) with major influence in the formation of zonal soils.

Keywords: rehabilitation, degraded soil, human intervention.

1. Introduction

It is known that the soil is the most important natural resource of the agricultural system and at the same time it records the most rapid and intense changes due to uncontrolled human interventions having huge negative repercussions, sometimes for a long period of time, also on other components of the environment. Currently, in our country, together

with the changing of the forms of ownership and of land management, the forecast on the evolution of agricultural land will continue to be unsatisfactory. The most aggressive threats on Romanian soil are both natural and in particular anthropogenic: climate change, loss of organic matter, low levels of nutritive elements (nutrients) to feed plants, acidification and eutrophication, heavy metals contamination, soil erosion, pesticide pollution, soil compaction and dismantle, salination, which all accumulated lead to serious losses in biodiversity [8].

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The aim of the research is to pedoagrochemically characterize the eroded antrosol (disturbed soil by aggressive human intervention) and to determine the amount of work required for ecological reconstruction of the affected area of 1,200 square meters.

The importance, originality and novelty of this research into agricultural land degradation field, highlights the transition period in our country with an unclear legislation and a general uncertain status at all levels, where large companies in the pursuit of profit do not take into account the destruction and degradation of the physical condition of soil by excessive compaction and contamination with various substances in the technological drilling processes the companies use in natural gas exploration.

In these complicated situations complex measures are needed to rehabilitate these lands with huge costs, over a long period of time until they are to be returned to agricultural use.

2. Material and Method

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

The figure below illustrates the administrative settlement of the studied area on Google Earth (Fig. 1) and in Photo 1 it is displayed the area with the land degradation level by aggressive human intervention from the Natural Gas Company Romgaz SA Media .



Figure 1. Bordering the degraded land surface in the area [12]

To develop this research, there were performed (Photo 1) measurements, observations and soil sampling at depths of 0-20 cm, 20-40 cm, 40-60 cm, with the drill-type pedoagrochemical probe for pedoagrochemical analysis, from the disturbed land after human intervention from the National Gas Company Romgaz SA Media and from the neighboring undisturbed land, respectively a proxicalcaric regosol, to correctly determine the type of degraded soil and the complex ecological restoration measures to be taken for its rehabilitation and returning into agricultural use.

The research and observations were based on studying and describing the pedoagrochemical

characteristics of the degraded soil, making the specific field and laboratory analysis, the assessment of the fertility condition of the soil and its suitability for agriculture and horticulture.

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



Photo 1. The destruction of land by human activity from the Natural Gas Company Romgaz SA Media

3. Results and Discussions

The measurements and findings made on the spot revealed that the land is located in the outside area of aga village, Cluj county, having 1,200 square meters, with a geometric shape as a regular quadrilateral and it is located on a short slope, with a slight slope between the access road and the lake, it is an arable farmland, suitable for most field crops (wheat, barley, oats, corn grain, corn silage, sugar beet, clover, vegetables potatoes, soybeans, rye), vegetable crops in the field and shelter areas of fruit shrubs and fruit trees and vineyards.

The pedoagrochemical analysis results in the field and laboratory revealed major changes in the quality of the disturbed soil (eroded antrosoil) by aggressive human intervention, being

in the fourth class of quality, as it can be seen from the pedoagrochemical characterization (Table 1) and the record of evaluation.

As a result of the high level of degradation of soil, fertility and the main quality features decreased drastically, requiring a set of special rehabilitation measures for lifting the productive potential of these areas.

Pedoagrochemical description of the anthropogenically disturbed soil - eroded antrosoil (Photo 1, Table 1 and record of evaluation, Table 2): the eroded antrosoil identified in the anthropic disturbed perimeter by man-made transformations due to aggressive interventions with heavy machinery from the National Gas Company Romgaz SA Media in the area and to soluble salts used in the drilling technology.

Table 1. 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	Netas
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 2. Evaluation for soil disturbed by anthropogenic activities of The Natural Gas Company Romgaz S.A. Media , Location: aga village, outside aga village, Cluj County. The geographical coordinates of the profile: 47°18'08"N, 22°24'40"E. Land degraded by the influence of human activities from The Natural Gas Company Romgaz SA Media , 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° 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	Pseudogleyization	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.

The results obtained, based on the pedoagrochemical study compared with the proxicalcaric regosoil dominant in the area, highlight the route to eroded antrosoil soil type due to aggressive human intervention, finding the following effects: due to the uncovering shallow horizon, firstly the edafic volume of the soil decreased from 88 to 63%; at the same time 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; 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 hydric 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 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 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.

The volume of specific works to rehabilitate the degraded land eroded antrosoil on a 1220 sqm surface, are the following:

Uncovering and removing of the land layer destroyed by human intervention (approx. depth 40 cm): the volume of the work = $1200\text{sqm} \times 0.4 = 480$ cubic meters of ground.

Machinery transport using an oversized trailer, roundtrip (time is varied, price - negotiable).

Scarifying with a heavy bulldozer to 60 cm: working time - approx. 3:00 h.

Retrieving vegetable earth for 40 cm depth and leveling: the volume work = $1200\text{ sqm.} \times 0.4 = 480$ cubic meters of ground.

Managing organic fertilizer (manure) 40 t/ha: the volume of the work = $40\text{ t} \times 0.12\text{ ha} = 4.8\text{ t}$ manure.

Managing the calcareous amendments (5 t/ha): the volume of work: $5\text{ t} \times 0.12 = 0.6$ amendments.

Managing NPK fertilizers (800 kg fertilizer/ha): the volume of the work = $0.8\text{ ha} \times 0.12\text{ ha} = 0.096\text{ t}$ fertilizers.

Deep plowing: the volume of the work = 0.12 ha.

Disking - 2 passes: the volume of the work = $0.12\text{ ha} \times 2 = 0.24\text{ ha}$.

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 aga village, Cluj County by uncontrolled human intervention from the Natural Gas Company Romgaz SA Media :

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 Media , 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 using 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 delimitation of the horizons on the soil profile with major consequences on the characteristics of fertility, soil quality and suitability for crop production.

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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