

## IMPROVEMENT OF DEGRADED SOILS IN ARAD COUNTY

Anișoara DUMA COPCEA<sup>1</sup>, Nicoleta MATEOC SÎRB<sup>1,2#</sup>, TEODOR Mateoc Sirb<sup>1</sup>, Casiana MIHUȚ<sup>1</sup>,  
Lucian NIȚĂ<sup>1</sup>, Veaceslav MAZĂRE<sup>1</sup>, Antoanela COZMA<sup>1</sup>, Nelu Daniel POPA<sup>1</sup>

<sup>1</sup> University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania" from Timisoara, 300645, 119 Calea Aradului, Romania, Phone: +40256277001, Fax: +40256200296

<sup>2</sup> Romanian Academy, Timisoara Branch, CDRDR, Mihai Viteazu Boulevard, No. 24, 300223 Timisoara, Romania

### RESEARCH ARTICLE

---

#### Abstract

*The paper aims to assess the current state of degraded soils in Arad County and propose integrated strategies for restoring their fertility.*

*The final objective is to restore the productive potential of the lands, ensuring sustainable agriculture in the western region of Romania. The improvement of lands affected by excess surface and groundwater moisture involves a set of complex measures (hydro-ameliorative, agrotechnical and structural) aimed at the rapid elimination of surplus water and improving the natural drainage capacity of the soil. The efficient improvement of lands affected by compaction and acidification requires an integrated strategy that combines physical and chemical interventions. The sustainable improvement of soils in Arad County, mainly affected by compaction, temporary excess moisture and, locally, salinization or acidification, requires an integrated and personalized approach. The consistent application of these measures is vital for maintaining long-term fertility and ensuring competitive and sustainable agricultural production in the Arad region.*

**Keywords:** soil, degradation, improvement, compaction, acidification

#Corresponding author: nicoletamateocsirb@usvt.ro

#### INTRODUCTION

Agriculture through its role and functions is the major element of natural resources with high impact on environment which through its long term stability assures the base for durable resources. (Iliuță et.al, 2013; Țărău, 2013; Țărău et.al, 2000).

Incorrect, not complete, wrong agricultural exploitation affects deeply, quantitatively and qualitatively not only crop yield but also soil resources. Soil thesaurus represent a strategic natural resource which is regenerating in case of rational exploitation, providing food security. (Țăru et.al 2002).

From the synthesis of studies and research conducted in our country, it results that large areas of land are affected by one, two or more limiting factors of soil fertility.

It is estimated that the execution of all amelioration works that lead to the correction of limiting factors of fertility, could increase the production capacity of the entire agricultural area by 40-60%. According to some authors, the increase could even reach 90-100%. (Borza et al 2001; Borza et al 2002).

The term soil degradation means the loss of soil quality. In other words, soil degradation involves the reduction of soil production capacity, more precisely soil fertility, by

modifying their physical, chemical and biological properties, as a consequence of anthropogenic intervention. (Demeter et.al., 2001; Rogobete et.al, 1997).

The negative modification of soil properties can occur either through direct human intervention or indirectly as a result of anthropogenic action. (Karel et.al, 2002).

In the first case, we can exemplify the compaction process that occurs as a result of the improper application of agricultural technologies. In the second case, we can exemplify the deforestation activity that represents a direct intervention on vegetation but which has the effect of amplifying soil erosion. (Lucian Niță et.al, 2023).

It should be noted that the very common term land degradation has a broader meaning, which involves the modification of landforms, with an implicit impact on the soil. Due to the complex functions of soil and its vital role in terrestrial ecosystems, its degradation causes the breakdown of the balance of the entire region, affecting the interconnections and exchanges of the pedosphere with the other geospheres. (Stroia et.al, 2021).

The effects of soil degradation have an impact not only on their yielding capacity, but also on the quality of vegetal and animal produce and, implicitly, on the population

---

health. Recovering land quality is a difficult and long-lasting process that needs huge investment efforts over a long period of time. (Anișoara Duma Copcea et.al, 2013)

In general, Romania's agricultural lands are considered among the most fertile in Europe, due to all physical and chemical elements in the soil, which determines the growth of plants, and to the texture of the soil, the humus content, the soil reaction, the saturation in bases, salinity, hydro-physical character, etc., which creates favorable premises for organic farming. (Nicoleta Mateoc Sirb et.al, 2024).

### **MATERIAL AND METHOD**

For the purpose of this work, the structure of the geographical space in the high plains of Arad County was studied. Representing a relief step belonging to the Western Plain (Banato-Crișană Plain), the mentioned space includes several genetic types, units and relief subunits, within which a high area can be delimited at the contact with the hills, with altitudes of 125-190 m, represented by the sectors: Susag, Cermei, Mânereu, Târnova (made up of fluvial-lacustrine and fluvial-colluvial deposits), Nădlac (made of loessoid-eolian deposits) and a digression area with altitudes of 99-100 m, representing the least drained area of: Crișului Plain, Șiriei Plain, Aradului Plain, Ineului Plain, Livadei Plain.

The high plains occupy the highest part of the sub-hilly area, formed by the convergence of sub-hilly glacis, intensely shaped by a network of valleys (generally marshy or subject to flooding) and are represented within the researched area by: Nădlac Plain, Cermei Plain, Măneră Plain and Târnovei Plain, which together have an area of 137,958 ha, of which 108,258 ha are agricultural lands.

The origin of the plain is attributed to the great Pleistocene delta of the Mureș. From a lithological point of view, the studied surface is characterized by a succession of strata of different ages, thicknesses and granulometric composition depending on the form of meso and microrelief, over the Pliocene lacustrine deposits (piled under the mountain) followed in the Quaternary a strong accumulation through the twinning of dejection cones made up of sands and clays based on gravels and loams in the upper part.

From a hydrographic point of view, the studied area belongs to the hydrographic basin

of the Crișul Alb and Cigherul with its tributaries.

From a climatic point of view, the studied area presents a temperate continental climate with oceanic and sub-Mediterranean influences with annual temperatures ranging between 10.5°C – 11°C and average annual precipitation ranging between 550 and 600 mm.

The vegetation encountered in the studied area is typical of the transition zone between steppe and forest-steppe (for lands affected by hydromorphism).

As a result of the geographical settlement in the former Mureș delta, at the interference between the low plain and the hills, the studied territory presents varied geological and physical-geographical conditions closely related to the local specific base level of the depression, which conditioned the formation of a complex soil cover.

### **RESULTS AND DISCUSSIONS**

According to the SRTS 2003 and 2012, respectively, 13 soil types and associations with numerous detailed units were identified within the designated area, which are distinctly distinguished by their properties, productive capacity and measures to maintain and increase fertility, comprising 7 of the 12 soil classes (Protisols, Chernisols, Cambisols, Luvisols, Vertisols, Hydrosols, Antrisol).

Depending on the values of the land use indicators for each of the main categories of use existing at the time of mapping (PS-pasture, FN-fields, AR-arable), land use scores were calculated, based on which the lands were classified into quality classes, from I to V, grouping the land use scores from 20 to 20 points as follows: class I- 81-100 points; class II- 61-80 points; class III- 41-60 points; class IV- 21-40 points, class V- 1-20 points.

the assessment scores for eight crops with the largest distribution area, namely: Gr-wheat; Or-barley; PB-maize; FS-sunflower; CT-potato; SF-sugar beet; SO-soybean; MF-peas/beans.

The arable land occupies an area of 87788 ha.

Limiting factors of agricultural land productivity

The limiting factors that affect the potential of the soil cover in the studied area refer to limitations due to excess stagnant and phreatic moisture, (table 1; figure 1) the degree of compaction (settlement) and acidification (table 2; figure 2), which is why, on a case-by-

case basis, pedo-hydroameliorative measures (drainage, drainage, deep loosening) are required to favor the development of concentration processes to achieve a balanced aero-hydric regime and measures aimed at favoring the development of concentration

processes of nutrients and organic matter in the soil (ameliorative fertilization, long-term rotations with ameliorative plants from legumes, perennial grasses, etc.)

Table 1

The situation of lands affected by excess surface and groundwater moisture

Nr crt.	Location	Total ha (agricultural)	of which lands with:						
			excess surface moisture			excess groundwater moisture			
			low	medium	strong	low	medium	strong	very strong excessively
1	Beliu	5570	1320	870	99	295	2537	433	19
2	Bocsig	6903	752	2368	0	2906	166	41	28
3	Cermei	11204	840	2795	2728	1916	2190	1714	235
4	Craiva	7421	1296	3826	556	827	398	90	118
5	Ineu	8660	1486	3232	1104	1090	3680	574	160
6	Nădlac	12116	0	0	0	5945	2773	732	531
7	Pecica	18805	0	244	0	207	4965	3272	244
8	Pâncota	5985	0	102	0	1005	1562	1921	1005
9	Semlac	7298	0	0	0	336	299	0	175
10	Șeitin	6080	0	0	0	347	553	523	116
11	Șepreuș	5268	170	1273	218	1330	1468	1848	84
12	Târnova	12951	4531	3726	714	1156	1584	91	130
13	Total area	108258	10395	18436	5419	17360	22175	9510	2845
14	Percentage limiting factors	-	9.60	17,03	5.01	1,60	20,48	8.78	2,63

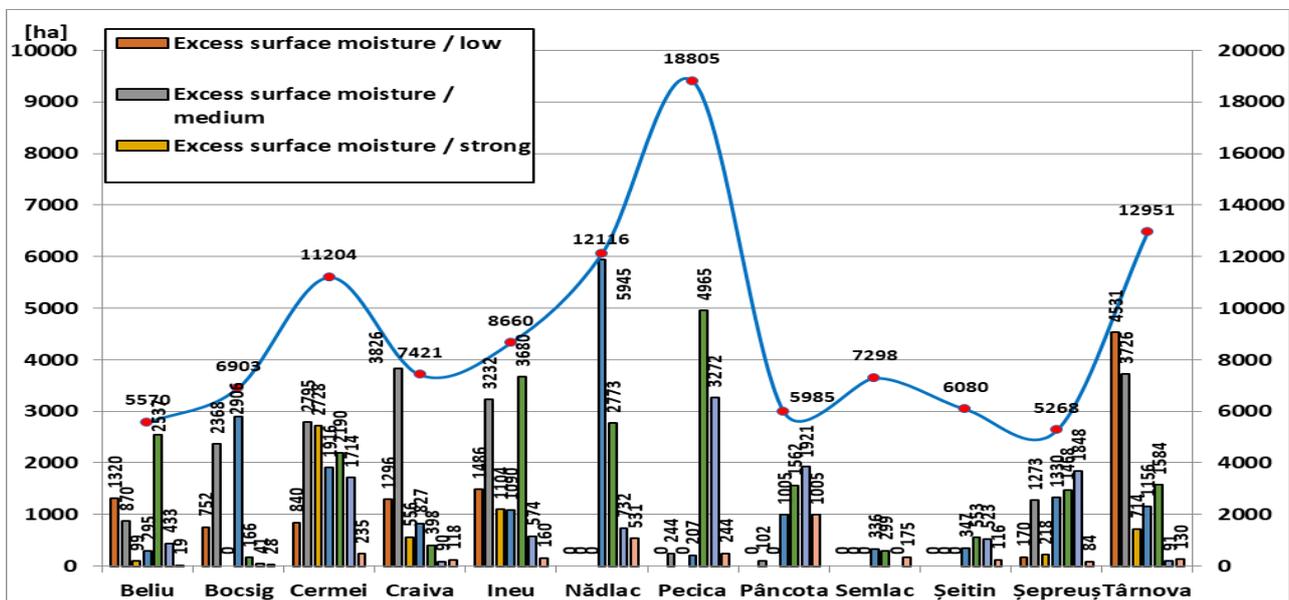


Figure 1 The situation of lands affected by excess surface and groundwater moisture

Table 2

**Situation of lands affected by compaction and acidification**

Nr crt.	Location	Total ha (agricultural)	of which lands with:					
			compaction			acidification		
			low	medium	very strong excessively	low	medium	very strong excessively
1	Beliu	5570	1063	2109	818	884	3663	399
2	Bocsig	6903	2050	752	3307	3210	3507	0
3	Cermei	11204	347	1160	9697	5115	5384	0
4	Craiva	7421	827	404	5741	1569	5504	230
5	Ineu	8660	1031	2052	4036	5118	2737	0
6	Nădlac	12116	10358	1115	434	154	0	0
7	Pecica	18805	4288	7033	7484	9177	1937	0
8	Pâncota	5985	215	2747	2819	30	51	0
9	Semlac	7298	3488	584	3043	2058	1576	0
10	Șeitin	6080	4761	930	0	669	0	0
11	Șepreuș	5268	410	1788	3070	3286	544	0
12	Târnova	12951	844	1636	8492	3337	8115	0
13	Total area	108258	29682	22310	48941	34607	33018	629
14	Percentage limiting factors	-	27,42	20,61	45,21	31,97	30,50	0,58

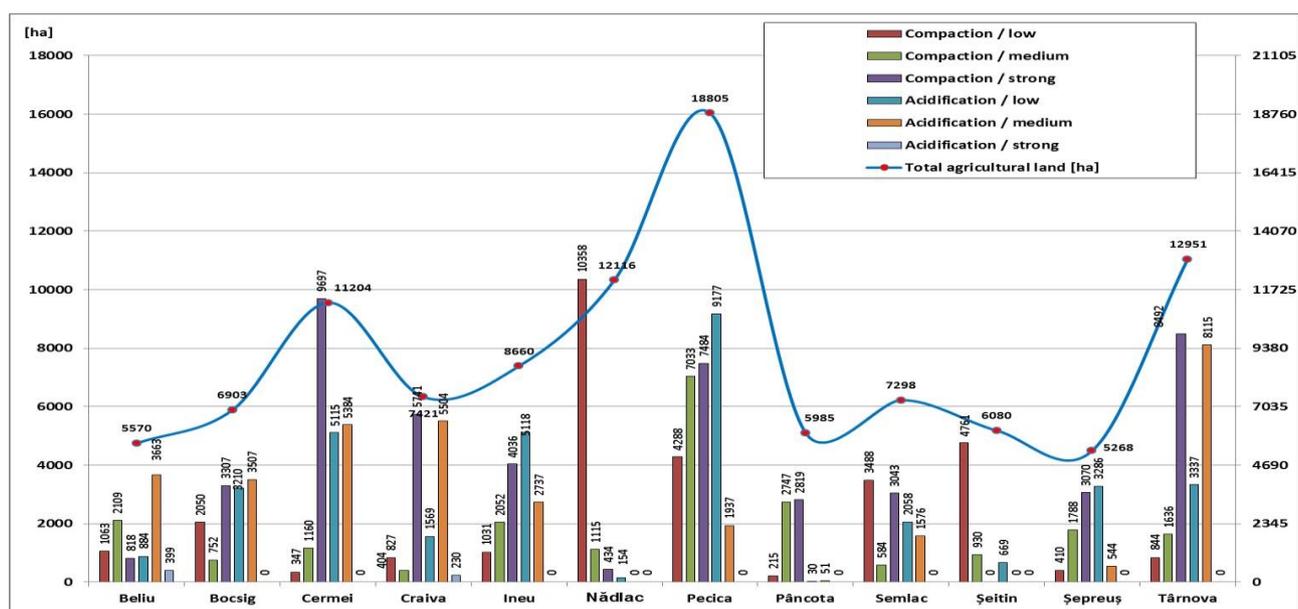


Figure 2 Situation of lands affected by compaction and acidification

In soils with excess moisture, aeration being insufficient, oxidation processes proceed poorly and therefore the mineralization processes of organic matter are slowed down. Also, the oxidizing compounds of Fe and Mn pass into reduced compounds whose combinations with the silicate part of the soil give a greenish-blue-purple color.

The excess moisture of agricultural lands, between the drainage channels, has increased as a result of the new conditions for organizing

the agricultural territory. By fragmenting it into numerous lots, of different sizes and orientations, in the drainage plot, the runoff is reduced and the collection and evacuation of water is diminished. Also, the excess moisture is increased, as a consequence of the unsatisfactory involvement in the maintenance of the drainage channels of the patrimony holder and the lack of participation of farmers in their exploitation, even leading to the degradation of the works. The causes of excess

soil moisture are multiple and act, as the case may be, individually or in association, in various ways.

As a result, soil improvement measures also differ from case to case. Excess moisture can be generated by a series of natural or artificial sources and is influenced by the presence of external and/or internal factors. If the excess moisture is temporary, the reduction processes alternate with the oxidation ones and the ferrous and manganese products pass into ferric and manganese products (iron and manganese hydroxides) which are deposited in the form of spots, concretions (bovines) and give a reddish color.

Soil drainage can be considered a result of the hydrophysical properties of the soil. Drainage is understood as the possibility of removing excess moisture from the soil.

To prevent and combat the phenomenon of soil compaction, in addition to periodic loosening works (plowing at different depths from one year to the next), it is necessary to apply a long-term rotation and improve the structure of crops with the appropriate participation of perennial grasses and legumes in order to increase the humus content and improve the physical, chemical and biological properties of soils under the conditions of an appropriate equipment with machines and equipment to ensure the execution of soil works in optimal periods.

Increasing the productive potential of agricultural land involves the practical application of a complex of measures and works, among which amelioration works play a special role.

Therefore, amelioration works are technical interventions whose purpose is the rapid and sustainable improvement of unproductive or poorly productive soil, by eliminating the factors that limit its fertility.

### CONCLUSIONS

Although the study area has good ecological potential, the current state of soil quality is poor. Most of the area is affected by one or more factors that limit or hinder optimal land use. The general way in which the soil can be used (utility) is in harmony with the natural soil and climate (pedoclimatic) conditions specific to the area.

In order for these lands to be more productive, it is absolutely necessary to carry out improvement works (improvement). The most important measures are: works to remove

excess water (drainages, drainage); works to improve the soil structure (e.g. deep loosening); correct fertilization (use of organic and mineral fertilizers and cultivation of plants that improve the soil (legumes, such as alfalfa or peas).

However, current land use is not always adequate for sustainable and long-term management of land resources. Without active and correct (ameliorative) interventions, the soil will not reach its maximum production potential.

### REFERENCES

- Borza I., Țărău D., Țărău Irina, 2002. Limitation factors and terrain yield increasing measures in Vinga high plain. Scientific papers, Faculty of Agriculture, XXXIV, Ed. Oriz. Univ. Timisoara,
- Borza I, Tarau D, Tarau Irina, 2001. Soils degradation process and restoring measure met in south-west Romania. Proceedings of the Symposium Restoration Ecology, University of Agricultural Sciences, Timisoara, Editura Orizonturi Universitare
- Duma Copcea A., Mateoc-Sirb N., Mateoc T., Niță L., Sirb S.Gh., 2013. Study on soil quality improvement in Romania. *Lucrări Științifice – vol. 56(2), seria Agronomie.*
- Demeter T., Geanana M., 2001. Pedological cartography. University of Bucharest Publishing House.
- Iliuță, A., Țărău D, 2013. Fertility limitative pedological factors approach and soil yield capacity recovery actions in Arad county. *Research Journal of Agricultural Science*, 45 (4).
- Karel Iaroslav Lațo<sup>1</sup>, Alina Lațo<sup>1</sup>, Lucian Dumitru Niță<sup>1</sup>, Anișoara Duma-Copcea<sup>1</sup>, Mihai Teopent Corcheș<sup>2</sup>, 2022. Pedo-genetical factors implicated in soil degradation (lower timis river basin area). *Scientific Papers. Series A. Agronomy*, Vol. LXV, No. 1, 2022 ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785.
- Mateoc-Sirb N., Paula Diana Otiman, Adelina Venig, Saida Feier David, Camelia Mănescu, Anișoara Duma Copcea<sup>1</sup>, Teodor Mateoc, 2024. Analysis of the dynamics of organic agriculture in the European union with an emphasis on Romania. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 24, Issue 2*, 2024 PRINT ISSN 2284-7995, E-ISSN 2285-3952.
- Niță L.D., Dorin Țărău, Gheorghe Rogobete, Florin Crista Simona Niță, Karel Iaroslav Lațo<sup>1</sup>, Anișoara Duma Copcea, Alina Lațo, Adalbert Okros, 2023. Physical-geographical and socio-economic conditions defining the quality of the eco-pedological resources in the Timișoara metropolitan area. *Scientific Papers. Series A. Agronomy*, Vol. LXVI, No. 1, 2023 ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785.
- Rogobete, Gh., Țărău, D., 1997. Soils and their improvement. Map of Banat soils. Marineasa Publishing House, Timișoara.
- Stroia Marius, Mazăre Veaceslav, Stroia Ciprian, Mihut Casiana, Duma Copcea Anișoara, 2021. Étude des sols de la commune de Dinaș, département

---

de Timis, pour leur amélioration. Știința în Nordul Republicii Moldova: realizări, probleme, perspective", Bălți, Moldova, 29-30 iunie.

Țărău D., Rus Gh., Vlad H., Florea M., Gherbovan F., Gherman A., Mazăre V., 2002, Acreage resources and main present and perspective productivity issues in Arad County. Lcr. St. State

University of Moldavia , Economics Faculty 2nd part

Țărău D, Rogobete Gh., Borza I, Beutura D., 2000. Acid soil in Banat, their actual state and improvement requirements. CIEC 21-22 aug 2000, Suceava, Romania, Pol of fertilizers in sustainable Agriculture, Romania National Branch of CIEC 9.

OSPA Arad Archive.