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PHYSICO-GEOGRAPHICAL CONDITIONS DEFINING THE QUALITY AND QUANTITY OF RESOURCES IN ALMĂJULUI VALLEY AREA, CARAȘ-SEVERIN COUNTY

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Abstract

The undertaken research is found in the current scientific and practical concerns regarding the accumulation of knowledge regarding the physical-geographical conditions as elements defining the quality of ecopedological resources. Ecopedological resources constitute a subsystem that is closely related to plant and animal associations, together forming terrestrial ecosystems, they have the ability to transform cosmic energy into potential energy that can be stored in plant and animal biomass. Soil is a unique environment that contains energy accumulated through a multitude of pedogenesis, non-renewable, inherited processes and solar energy is linked to the existence of mankind. The Almăj Valley area, in this paper, is a project comprising seven territorial administrative units included in this area on an area of 109518 ha. The paper provides basic information and methodological elements regarding the qualitative evaluation of ecopedological resources and possible pressures on them, thus integrating into the wider field of complex studies of natural resources. The physical and geographical conditions of soil formation and evolution are briefly presented, mentioning how the zonal peculiarities of the considered space determine a great diversity of ecological conditions.

Key words*: soil, quality, rural, resources, sustainability.*

INTRODUCTION

Sustainable management of natural and anthropogenic resources is a modern form of ecosystem management that aims at maintaining and enhancing biodiversity and allowing the long-term production of high-quality products, which is why the localization and definition in the terrestrial space of each portion of land play an important role in determining the ecological conditions and the vocation of a certain part of land for certain utilities (agricultural, forestry, social-economic).

Among the factors and the physical-geographical conditions determining the environment in which plants grow and yield crops, the soil presents a major component, which has the role, on the one hand, of a complex indicator of the state of evolution of the characteristics that determine the growth of plants, and on the other hand, of depositary of the influence of all other conditions and factors. Numerous studies and researches at national level have highlighted the interdependence relations between agricultural technology systems, the state of the environment, the level of economic development and the quality of life (Borcean et al., 1996; Canarache and Teaci, 1980; Coste at al., 1997; Dumitru et al., 2000; Ianoș et al., 1997; Munteanu, 2000; Răuță, 1997; Rogobete et al., 1997; Teaci, 1980; Țărău et al., 2017; 2018).

The considerations briefly presented determine the authors to present some aspects regarding the use of pedological information, accumulated in pedological studies and stored in the archive of O.S.P.A. Timișoara mostly on classical support, but also on the basis of the SPED 1 information system (used at O.S.P.A. Timişoara since 1988) and the BDUST system - implemented in the territory by I.C.P.A. Bucharest, since 2002, but also based on research programs carried out over time by authors, within OSPA, ULS (USAMVB) and UPT in Timisoara, for the qualitative evaluation of ecopedological resources in Almăjului Valley and possible pressures on

them, but also on measures to promote environmentally friendly social practices.

MATERIALS AND METHODS

The problem addressed refers to an area of 109,518 ha (Table 1) of which 40,628 ha (37.11%) are agricultural land and 60,323 ha (37.11%) land with forest vegetation 66,103 ha (60.33%), located in Almăjului Valley, which administratively belong to 7 territorial administrative units (ATU) in Caraș Severin County.

From the analysis of the situation of land use categories in the Almăj Valley depression, it can be seen that important areas are occupied by pastures and meadows, representing approximately 27.5% of the total area and over 74% of the agricultural area of the area. The arable use category is only 21.77% of agricultural area (Table 1). The Almaj depression area has a long tradition in practicing agriculture, and this activity plays an important role in the local economy. Agriculture can be divided into two aspects: traditional agriculture and modern agriculture.

Traditional agriculture is based on methods and techniques passed down through generations and is often linked to traditional farming practices of the area. Farmers use their inherited knowledge and techniques to grow traditional crops such as cereals (wheat, maize), vegetables and fruits. They rely on local climatic conditions and the natural resources available in the area.

Table 1. Situation of the land fund in Valea Almăjului

No.	Teritorrial Administrative Unit (TAU)	Arable	Pasture	Grassland	Vignards	Orchards	Total agricultural	Forests	Waters	Other categories	Total general
1	Bănia	1720	4566	853	0	377	7516	12437	75	564	20592
2	Bozovici	1177	4300	1514	0	323	7314	11486	69	710	19579
3	Dalboșeț	1224	2674	1201	0	140	5239	3061	61	266	8627
4	Efitime Murgu	994	1706	478	0	315	3493	6103	63	211	9830
5	Lăpușnicu Mare	707	3281	1444	0	222	5654	6446	57	209	12366
6	Prigor	2089	3591	1714	0	291	7685	22075	60	367	30187
7	Șopotu Nou	935	2058	694	0	40	3727	4495	12	103	8337
Total (ha)		**8846**	**22176**	**7898**	**0**	**1708**	**40628**	**66103**	**397**	**2430**	**109518**
% total area		**8.08**	**20.25**	**7.22**	**0**	**1.56**	**37.11**	**60.33**	**0.36**	**2.20**	**100**
% total agricultural		**21.77**	**54.58**	**19.44**	**0**	**4.21**	**100**	-	-	-	-

On the other hand, modern agriculture has brought a number of technological and scientific innovations to improve productivity and efficiency. Farmers have adopted modern irrigation, fertilization and crop protection techniques to obtain higher yields and higher quality. The use of modern agricultural machinery and equipment has also helped to increase efficiency and reduce the physical effort required.

The Almăj Depression broke off like a bay, during the Miocene in the former Pannonian Sea, then during the Pliocene, due to postorogenic movements, it was divided as a depression, and the filling is made of gravel, calcareous sandstones, limestone with Lithotamnium and sandy clays.

Almaj Depression is also known as Almaj Land, Bozovici Depression or Nera Depression. Broadly speaking, its boundaries coincide with the boundary between the crystalline rocks that make up the surrounding mountains and hills and the Miocene sedimentary deposits into which the depression is carved. The relief of the depression consists of long peaks, perpendicular to the Nera, more developed in the south. The altitude of the peaks is 400-450 m in the east and 300-350 m in the west and forms an erosion level that cuts sedimentary formations. Below the erosion level, seven terraces are floored, some of them passing along tributaries. They are more developed on the left side of the Nera River, further accentuating the asymmetry of the depression reported in this river.

The research of the ecopedological conditions was done in accordance with the Methodology of the Pedological Education Elaboration (vol. I, II, III) elaborated by ICPA Bucharest in 1987, supplemented with specific elements of the Romanian Soil Taxonomy System (SRTS-2012), as well as other normative acts updated

by MAAP Order 223/2002, respectively Order MADR 278/2011, based on the pedological information acquired in the OSPA archive in Timişoara (for more than 68 years), but also based on the research carried out in time by the authors (within OSPA, BUASVM and PU from Timişoara), studies that were supplemented with elements recently collected from the field.

RESULTS AND DISCUSSIONS

Geology/Geomorphology of the studied area

Separated from the Locvei Mountains by the small depression Sicheviţa-Liubcova-Şopotu Nou, they are bordered to the north by the Nera River by the Almăj Depression, after an alignment Şopotu Nou-Rudăria-Lăpuşnicel-Iablaniţa, to the east by the Timiş-Cerna corridor by the Cernei Mountains and Mehedinti Mountains (Iablaniţa-Mehadia-Orşova alignment), and to the south, by the Danube. This massif has several peaks, mostly forested, whose maximum altitude is at the peak of Svinecea Mare (1224 m). The dominant geological formations in the Almaj Mountains, crystalline shale, intrusive bodies and sedimentary cover, belong to the native Danubian. The massifs of basic rocks are present at Jutes-gabbos with dialage, with olivine, crossed by veins of alite, lamprophyrs and porphyries; at Plavişeviţa - gabbos with breccings and supports the serpentinite massif from Tisoviţa - pyroxenites, lamprofires, granodiorites also appear here.

Mesozoic, belongs to the Sicheviţa-Svinecea area, in the western part of the Almăj Mountains and consists of carboniferous deposits that bloom in the marginal parts (Geology of Romania, 1973). The coal deposits are made of conglomerates, clay shale, coal in which the coal of Bigăr, Cozla and Baia Noua appears. The Permian, consisting of clay shale, red clays, red sandstones, occupies the Carboniferous and is restricted to Drencova and very thick in the Svinitsa area.

It represents the end of the Southern Carpathians, being situated between the Danube, to the south, and the Nera north, northwest and west. Near Nera and the Danube, Locvei Mountains gradually descend with the modification of rocks from crystalline shale to loess band on fluvial deposits about 4-5 km wide in the Plain-Baziaş area, only 100-300 m at Moldova Noua-Sicheviţa. The eastern limit of Locvei Mountains can be considered the valley of Sichevita, and to the north Şopotu Nou (Nera). Due to the radical modification of the rocks, from shale to limestone (belonging to the Resita - Anina - Sasca area) some geographers have separated for this limestone band 15-20 km wide, the mountain unit called Gorgan Mountains

In the central area of Locva Mountains appears an intrusive gneiss body with littes, and in the continuation of Anina Mountains the body of calcareous rocks is represented by limestone, dolomitic limestone, conglomerates, sandstones with intercalations of coal clay, marls, bituminous clay. It is bordered by Semenic Mountains, Anina Mountains and Almăj Mountains and is crossed by the Nera River. Its size is 40 km/15 km. It consists of deposits 500-600m thick, of conglomerates, limestone sandstones, sands, gravel, marls, with intercalations of coal and tuffs.

Relief and hydrography

The relief is characterized by mountain formations and hills, with heights ranging from 200 to 1,400 meters. The Anina Mountains dominate the landscape, offering spectacular panoramas and a variety of tourist routes. Some of the notable peaks include Țarcu Peak (1,407 m) and Petreasa Peak (1,178 m).

The relief is dominated by the Banat Mountains mountain range, which stretches in the south-western part of the locality. This mountainous region offers spectacular landscapes and is appealing to tourists and nature lovers.

In the north there are the mountain peaks and deep valleys of the Banat Mountains, which are a beautiful area for hiking and mountain exploration. Here you can find landforms such as ridges, peaks, peaks and mountain ridges, which offer impressive panoramas over the entire region. In the south are the hills and plains near the border with Serbia. These areas have a less rugged terrain and are suitable for agricultural activities and rural development.

As for hydrography, it is crossed by several rivers and streams. One of the most important watercourses is the Bozovici River, which crosses the commune from west to east. It flows into the Nera River, a tributary of the

Danube. Other important tributaries of the Nera River are the Ravena stream and the Răchita stream. These watercourses contribute to the creation of picturesque landscapes and the development of rich and diverse ecosystems.
The hydrography of the area also provides opportunities for fishing and water sports in the right areas of rivers and streams. The relief and hydrography of the area contribute significantly to the natural beauty of the area and to the diversity of landscapes, providing opportunities for recreational and tourist activities in harmony with nature.

Vegetation and fauna

The vegetation is diverse and influenced by the climate and geographical features of the area. Depending on the altitude and type of soil, different types of vegetation can be encountered. In mountainous areas, vegetation is dominated by coniferous forests, such as fir (*Picea abies*), spruce (*Abies alba*) and pine (*Pinus* sp.), which form true forests above an altitude of about 1,000 meters. Other tree and shrub species are also found in these forests, such as beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*) and yew (*Taxus baccata*).
These forests are home to a variety of wild animals and birds. In the lower areas and on the less inclined slopes, mixed forests are found, in which deciduous species such as oak (*Quercus robur*), elm (*Ulmus* sp.), acacia (*Robinia pseudoacacia*) and poplar (*Populus* sp.) are found. Apart from forests, the Almaj Valley is also characterized by plain vegetation and meadows. Here are found species of grasses, wildflowers and perennials that contribute to the diversity of the landscape.
The fauna is equally varied and offers opportunities for observing and studying local biodiversity. Several species of mammals live in the forests of the area, such as deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), fox (*Vulpes vulpes*) and brown bear (*Ursus arctos*). Small mammal species such as the squirrel (Sciurus vulgaris) and wasps (*Meles meles*) can also be found in this region. As far as birds are concerned, numerous species are present, including the owl (*Bubo bubo*), woodpecker (*Dendrocopos* sp.), blackbird (*Turdus merula*) and pheasant (*Phasianus colchicus*).

În apele curgătoare și lacurile din zonă se găsesc diferite specii de pești, precum păstrăvul (*Salmo trutta*), mreana (*Barbus barbus*) și cleanul (*Chondrostoma nasus*), oferind astfel oportunități pentru pescuit și observarea vieții acvatice.
The rivers and lakes in the area are home to different species of fish, such as trout (*Salmo trutta*), barbel (*Barbus barbus*) and barbel (*Chondrostoma nasus*), thus providing opportunities for fishing and observation of aquatic life. The rich vegetation and fauna of Almaj Valley contribute to the beauty and natural diversity of the area, being an important aspect in attracting tourists and promoting ecological tourism and outdoor activities.

Soils and Pedogenesis Processes

The soils of the studied territory were born as a result of the interaction of the main pedogenetic factors: climate, relief, mother rock, vegetation and groundwater. These factors cannot be interpreted separately because they condition each other. The greater or lesser influence of one or more of these factors has led to the emergence of different soils. In the meadow area, through the overflows of the Nera River, alluvial materials have always been deposited over other more or less solified materials. This is how alluvial soils were formed. In the immediate vicinity of the Nera riverbed, gleiosols were formed, where groundwater was on the surface, as well as psamic and gleic alluvial soils.
At medium distances from the major riverbed there are highly humified, deep alluvial soils. At great distances there are relatively young soils such as eutricambosols or districambosols affected by different stages of gleization. Both gleization and stagnogleization processes occur on the terraces, giving rise to soils such as eutricambosols and districambosols, as well as preluvosols and luvosols. As the slope of the land increases, erosion processes also occur, their intensity varying in direct proportion to the slope.
In the hilly area due to a parental material of coarse constitution, sand and gravel, the soils have not reached the maturity stage, being hindered by the erosion process. Under these conditions, young soils with a varied content of skeleton, soils such as eutricambosoils,

districambosols, regosols and erodosols were formed. Also in these areas occur a series of landslides currently semi-stabilized, these being caused in the not too distant past by massive deforestation followed by rainy periods. The slides were also possible due to the alternating stratification of clays with sands.

Within the researched space, Regosols and Preluvosols were identified. Regosols represent the initial stage of pedogenesis, developing in areas where soil formation processes are limited by geological erosion, accumulation of unconsolidated materials, restrictive climatic conditions, or parental materials brought up to date by landslides, usually found in association with lithosols, districambosols or eutricambosoils.

Table 2. The main types and associations of soils in the Almăjului Valley area

No.	Teritorrial administrative unit (TAU)	Agricol, ha	Types of soil															
			LS	RS	AS	RZ	EC	DC	EL	LV	EP	VS	PE	SG	GS	TB	AT	asc
1	Bănia	7516	0	1263	1030	0	0	849	1022	691	0	1458	0	624	173	0	0	406
2	*Bozovici*	7314	0	682	676	64	927	2620	1128	897	0	131	1	138	50	0	0	0
3	Dalboşeţ	5239	**0**	770	367	0	492	1106	681	618	0	0	0	157	142	0	906	0
4	Eftimie Murgu	3493	44	410	374	0	209	0	590	732	0	248	0	416	108	0	247	115
5	Lăpuşnic Mare	5654	57	68	639	0	1521	390	181	226	0	0	0	334	113	0	1322	803
6	Prigor	7685	**20**	520	14	0	90	2665	960	2890	90	0	0	0	120	30	286	0
7	Şopotu Nou	3727	88	205	48	8	860	984	1260	239	0	0	0	0	0	0	35	0
Total, ha		**40628**	**209**	**3918**	**3148**	**72**	**4099**	**8614**	**5822**	**6293**	**90**	**1873**	**1**	**1669**	**706**	**30**	**2796**	**1324**
%		**100**	**0.51**	**9.62**	**7.75**	**0.18**	**10.09**	**21.21**	**14.33**	**15.48**	**0.23**	**4.51**	**0.01**	**4.11**	**1.74**	**0.08**	**6.89**	**3.26**

Legend: LS- Leptosols; RS-Regosols; AS- Fluvisols; RZ –Rendsolls; EC- Eutric Cambisols; DC –Distric Cambisols; EL – Haplic Luvisols; LV- Haplic Luvisols; EP- Entic Pedzols; VS – Pellic Vertisols; PE – Chromic Vertisols; SG – Haplic Stagnosols; GS – Haplic Gleysols; TB- Distric Histosols; AT – Anthorosols.

According to the Romanian System of Soil Taxonomy (SRTS 2003, respectively 2012) within the space designated by the area of the 7 cadastral territories (Almăj Mountains, Locvei and Aninei, Bozovici Depression, 16 types and associations of soils were identified with numerous detailed units, which differ distinctly by the processes of formation and evolution, their properties, productive capacity and measures to maintain and increase fertility, being found in 9 of the 12 classes of soils (Protisols, Chernisols, Umbrisols, Cambisols, Luvisols, Vertisols, Hydrisols, Histosols, Antrisols).

Thus, on the basis of pedological information processed according to the Methodology for the Development of Pedological Studies (ICPA Bucureşti, 1987) and other normative acts updated by Order MADR 278/2011, the agricultural lands of the researched space can be grouped (from 20 to 20 points) in V classes (quality) according to their vocation for arable use (Table 3), their distribution in the five quality classes being different according to the local particularities.

The category of arable use occupies an area of only 8846 ha, and the distribution by quality classes (fertility) is as follows: class II 567 ha (6.42%), class III 3249 ha (36.73%), class IV 2956 ha (33.41%) and class V 2074 ha (23.44%). It can be noted that due to the natural conditions of soil formation, their quality faithfully and characteristically expresses the specific formation processes that caused the emergence of poorly fertile soils.

Table 3. Classes of suitability (quality) for category of use "ARABLE" (ha)

Teritorrial Administrative Unit (TAU)	Arable	Class I (81-100 pct.)	Class II (61-80 pct.)	Class III (41-60 pct.)	Class IV (21-40 pct.)	Class V (0-20 pct.)	Weighted average grade
Bănia	1720	0	88	770	494	368	34
Bozovici	1177	0	69	502	366	240	38
Dalboşeţ	1224	0	245	185	617	177	33
Eftimie Murgu	994	0	0	443	334	217	32
Lăpuşnicu Mare	707	0	72	241	189	205	31
Prigor	2089	0	93	828	721	447	36
Şopotu Nou	935	0	0	280	235	420	28
Total	***8846***	***0***	***567***	***3249***	***2956***	***2074***	-
%	-	***0***	***6.41***	***36.73***	***33.41***	***23.44***	-

Table 4. Classes of suitability (quality) for category of use "PASTURE" (ha)

Teritorrial Administrative Unit (TAU)	Pasture	Class I (81-100 pct.)	Class II (61-80 pct.)	Class III (41-60 pct.)	Class IV (21-40 pct.)	Class V (0-20 pct.)	Weighted average grade
Bănia	4566	258	1036	2734	308	230	53
Bozovici	4300	59	1153	2053	1035	0	53
Dalboşeţ	2674	120	180	1549	657	168	49
Eftimie Murgu	1706	96	120	1205	199	86	54
Lăpuşnicu Mare	3281	170	380	751	1520	460	51
Prigor	3591	250	480	1812	789	260	61
Şopotu Nou	2058	0	180	665	653	560	30
Total	***22176***	***953***	***3529***	***10769***	***5161***	***1764***	-
%	100	4.31	15.91	48.56	23.27	7.95	-

Pasture land occupies an area of 22176 ha in the 7 administrative territorial units in the Almăjului Valley area (Table 4), the classification in the

five quality classes for each cadastral territory registering different values, in most cases registering values of weighted averages with a score that classifies the pasture use category in classes II a (Prigor), III (Bănia, Bozovici, Dalboşeț, Eftimie Murgu, and Lăpușnicu Mare) and in IV grade - quality (Șopotu Nou).

Table 5. Classes of suitability (quality) for category of use "GRASSLAND" (ha)

Teritorrial Administrative Unit (TAU)	Grassland	Class I (81-100 pct.)	Class II (61-80 pct.)	Class III (41-60 pct.)	Class IV (21-40 pct.)	Class V (0-20 pct.)	Weighted average grade
Bănia	853	0	120	387	250	96	45
Bozovici	1514	53	422	733	245	61	52
Dalboşeț	1201	0	164	163	449	425	31
Eftimie Murgu	478	0	0	337	115	26	48
Lăpușnicu Mare	1444	0	78	425	714	227	35
Prigor	1714	150	362	652	390	160	52
Șopotu Nou	694	0	140	141	253	160	26
Total	***7898***	***203***	***1286***	***2838***	***2416***	***1155***	-
%	***100***	***2.57***	***16.28***	***35.94***	***30.59***	***14.62***	-

Referring to the meadow use category, it occupies an area of 7898 ha in the Almăjului Valley Depression (Table 5), the classification in the five quality classes (fertility) for each cadastral territory registering different values comprising all quality classes. The values of the weighted averages in the administrative territorial units of Bănia, Bozovici, Eftimie Murgu and Prigor with meadow areas fall into the third class of quality (fertility) and the localities Dalboșeț, Lăpușnicu Mare and Șopotu Nou with meadow areas falling into the IV-a quality class.

CONCLUSIONS

Knowing the natural conditions and especially the ecological potential of the lands (defined according to MESP-ICPA Bucharest, 1987) for the main categories of use and crops is of particular importance in carrying out the qualitative evaluation of lands, which justifies the necessity and the actuality of the pedological mapping activity and periodic agrochemistry, as well as the need to respect the frequency of field and laboratory investigations at all points in the 8x8 Km grid of the National Soil Monitoring System (organized by ICPA) and completing it with pedological and agrochemical studies.

The determination of the land production capacity as well as the foundation of the improvement technologies can be, for the decision-maker (Government, Local Public Administration), an effective tool for choosing working procedures that favour the efficient use of the land resources within the space researched according to the specific pedro-climatic conditions that allow the integration of the vegetal and animal sectors with the processing and selling of agri-food products, which can be an ecological and efficient solution for the future.

The systematic pedological and agrochemical mapping of soils carried out by the Pedological and Agrochemical Offices in our country offer valuable data on the evolution of soil quality, the differentiation and setting of crop technologies, the quality of land and the establishment of favorability for different crops, substantiating land improvement and improvement technologies, organizing and systematizing the territory.

In this respect, the methodology for elaborating pedological studies, ICPA (1987), integrates organically and unitarily the mapping of soils and other environmental conditions with multiple applicative aspects regarding the sustainable management of natural and anthropogenic resources, thus representing a modern form of land management, aiming at maintaining and increasing soil fertility.

The operation of classifying agricultural land in quality classes based on bonitation notes highlighted a series of limiting factors acting on the production capacity of agricultural land, within the researched area, among which we mention: granulometric composition (soil texture), humus reserve, soil reaction, degree of compaction or compactness, excess moisture, the slope of the land and the danger of eroding from the analysis resulting in a series of requirements and ameliorative measures and/or obliged uses, as well as requirements and measures to prevent degradation and preserve the fertility of soils - land.

In order to prevent its physical degradation, it is necessary to minimize the land preparation works, the agrotechnical works being carried out only at the optimal soil moisture, and in order to eliminate or reduce the listed limiting factors, the agropedoameliorative works will aim, in particular, at improving the aerohydric regime of the soil through rainwater capture

and evacuation measures, as measures to prevent and combat erosion, associated with those to improve the plant nutrition regime, by applying limestone-based amendments. Given the share of pastures, mostly degraded, radical measures are required to restore the green carpet where the phenomenon is predominant, and in the rest of the area occupied by this use, fertilization, amendment and overseeding measures associated with rational grazing are rigorously applied.

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