AGROSILVOPASTORAL SYSTEMS IN DISADVANTAGED AREAS. CASE STUDY

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Abstract. *The systemic and dynamic structure of the agro-forestry-pastoral systems unitarily integrates the way in which their components and the functional relations between them are arranged in space and time. It materializes through the intertwining of biological components (grassland vegetation, trees, animal species), technique - the use of resources: meadows and fodder crops and socio-economic (consumer products, financial resources, human component). The aim of the paper consists in the analysis from a territorial aspect of the analyzed area, of the way of use and exploitation, with emphasis on the meadows with a high biodiversity. In the inventory of the lands according to the use method, the Corine Land Cover database was used, 2018 edition, and for the establishment of the meadows with High Natural Value (HNV) the National Rural Development Program 2014 - 2020 was used. The data were processed with Autocad 3D Map and ArcGIS 10.2.1. By applying the specific methodology, land cover / land use maps, HNV meadow map and statistical data on grassland areas and agricultural crops were obtained. The territorial analysis shows that the largest share belongs to forests and pastures, the arable lands being distributed on small areas, generally fragmented. Among the agricultural crops predominate alfalfa, red clover, guide, triticale, rye and small areas with corn and wheat. In the analyzed area, sustainable agriculture is practiced, both in the extensive breeding of animals and in terms of cultivation technologies.*

Keywords: *agro-forestry-pastoral systems, disadvantaged areas, HNV meadows*

INTRODUCTION

The systemic and dynamic structure of agroforestry systems unitarily integrates the way in which they are arranged, in space and time (FAO, ICRAF. 2019), its components and the functional relations between them (DEVENDRA, 2016; CHARÁ ET AL, 2019). It materializes through the intertwining of biological components (grassland vegetation, trees, animal species), technique - how to use resources: grasslands and field crops and socio-economic (consumer products, financial resources, human component). By-products are also used in mountain areas: mushrooms, berries and medicinal plants (IMBREA ET AL. 2010).

Spatio-temporal diversification can contribute to the creation of multifunctional landscapes (GARIBALDI ET AL. 2019), which are more ecologically sustainable (YUAN-FARRELL, KAREIVA, 2006) and economically (BELL, MOORE, 2012; KREMEN, 2020). Agri-biodiversity systems, mentioned by Vogt (2021), consist of minimal proportions of arable crops and other areas with natural vegetation (forests, pastures, curtains of natural vegetation).

Most of the "green landscape", in the hilly and mountainous areas of Romania, is represented by forests and grasslands (BÂRLIBA, COJOCARIU, 2010; COJOCARIU ET.AL. 2015; SIMON ET AL. 2017a; SIMON ET AL. 2017b) and small areas of crops field, in arable, specific to pedoclimatic conditions (COJOCARIU, 2005; DAVID ET AL. 2010). Land productivity in these areas is low, with the risk of erosion (ONCIA ET AL. 2013; ONCIA, COPĂCEAN, 2015; COPĂCEAN ET AL. 2019), a lower soil microactivity (BOROZAN ET AL. 2013) leading to lower crop yields.

The current state of grasslands in Romania is deeply influenced by past agricultural practices (communist regime) when the aim was to increase grassland production by applying chemical and mixed fertilizers: manure and chemical fertilizers (MOISUC ET AL. 1994; MOISUC

ET AL. 1997) and the current period when most of the meadows have been abandoned, with very little or no input.

The current trend, according to European policies, is to preserve and conserve the biodiversity of grasslands (MOISUC ET AL. 2000; CĂLUȘERU ET AL. 2013) by applying differentiated technologies (IACOB ET AL. 2015), by allocating subsidies through PNDR 2014-2020.

Research projects in public-private partnership are also stimulated (IMBREA, 2011b, ȘUMULEAC ET AL. 2016), including those related to the improvement of plants and animals in sustainable agriculture systems; projects aimed at coordination, control and sources of financing in agricultural farms (IMBREA, 2011a; ANGEVIN ET AL. 2017).

The aim of the paper consists in the territorial analysis of the analyzed area, of the way of use and exploitation, with emphasis on the meadows with a high biodiversity.

MATERIALS AND METHODS

Study area

The territory analyzed in this paper is located in the western part of Romania, in the east of Arad county, on the border with Bihor county (in the north) and Alba (in the east) (Figure 1).

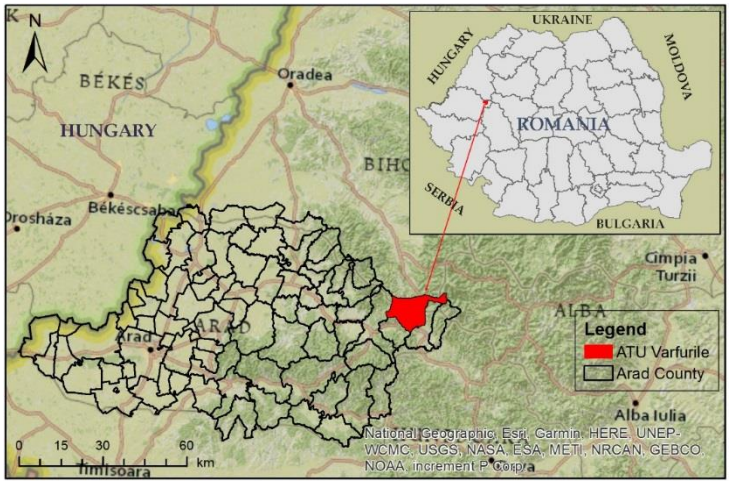


Figure 1 Location of the study area (processing after ANCPI)

As physical-geographical regions, on the territory of ATU Vârfurile intertwine: Codru Moma Mountains (in the northwest), Hidișelului Hills (in the north), Găina Mountains (in the northeast), Hălmagiu Depression (central-southern part) and on small area, Zarand Mountains (southwest) (RUSU, 2007).

Research methodology

The Corine Land Cover database, 2018 edition, was used in the land inventory according to the use, and the National Rural Development Program 2014 - 2020 was used to establish the High Natural Value (HNV) grasslands. The data were processed with the program ArcGIS 10.2.1.

By processing the Digital Elevation Model in the GIS environment, information such as altitude, slope and slope orientation were obtained.

By applying the specific methodology, land cover/use maps, HNV grassland map and statistical data on grassland areas and agricultural crops were obtained.

RESULTS AND DISCUSSION

In rural areas, within the agro-forestry-pastoral systems, we face two problems that have an impact on productions and their profitability: the cyclical nature of production (determined by the seasonality of natural and biological factors) and the instability of production, implicitly environmental and economic).

From the Digital Elevation Model (Figure 2) it can be seen that in ATU Vârfurile, the mountain areas have a marginal disposition, the maximum altitude of 1407 m being reached in the Găina Mountains, in the east of the territory. The minimum altitudes are registered in the Hălmagiu Depression, in the central area of Vârfurile commune.

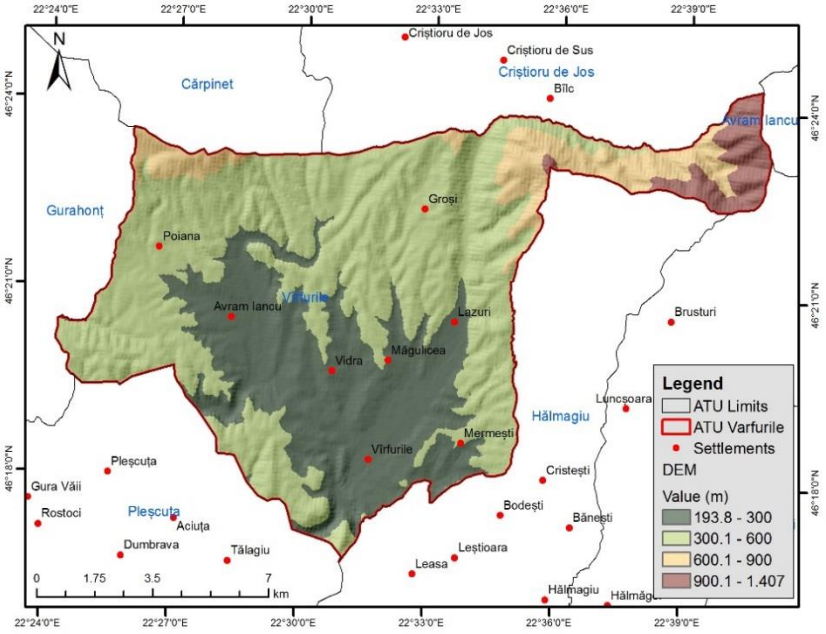


Figure 2 Distribution of surfaces on altitudinal floors (processing after EEA EU-DEM)

According to the histogram of the Digital Elevation Model (Figure 3), most of the land surfaces are located below the altitude of 600 m, so the distribution of altitudes on the four floors previously established is disproportionate, which is "reflected" in the land use.

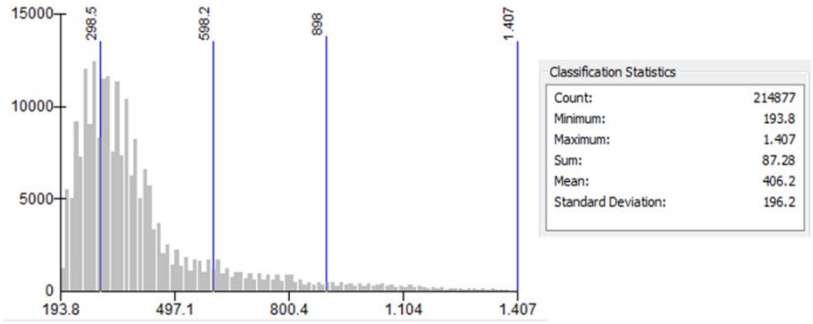


Figure 3 Histogram of the Digital Elevation Model

On geomorphological principles (altitudes, average slopes), PNDR 2014 - 2020 includes ATU Vârfurile in the "mountain area", the inhabitants benefiting from subsidies for disadvantaged area, which are cumulated with the other agri-environment and climate packages and ecological agriculture.

In the mountainous areas the forest surfaces predominate and in the area of the hills and in the depressive ones a mosaic use of the lands was identified: grasslands, orchards, complex crops in arable land, arable land (Figure 4).

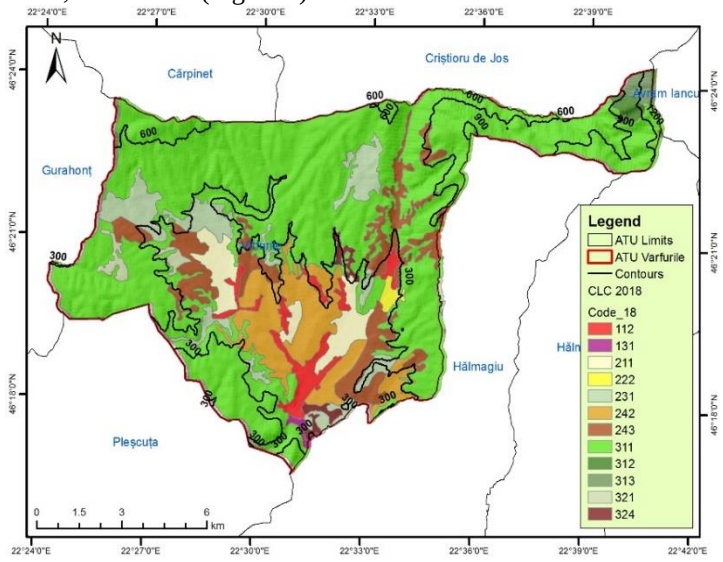


Figure 4 Spatial representation of land use in ATU Vârfurile (processing after EEA CLC 2018)

At the level of ATU Vârfurile, the largest areas belong to forests (deciduous, coniferous and mixed) totaling an area of 8820.28 ha, respectively 65.67% of the territory. According to the physical-geographical conditions, these areas are distributed in mountainous and hilly areas.

Table 1

Modul de utilizare a terenurilor în UAT Vârfurile (processing after EEA CLC 2018)

No.	Land use	Code CLC 2018	Area (ha)	% of total area
1	Discontinuous urban fabric	112	415.13	3.09
2	Mineral extraction sites	131	35.57	0.26
3	Non-irrigated arable land	211	512.97	3.82
4	Fruit trees and berry plantations	222	56.22	0.42
5	Pastures	231	947.91	7.06
6	Complex cultivation patterns	242	1168.63	8.7
7	Land principally occupied by agriculture, with significant areas of natural vegetation	243	1239.14	9.23
8	Broad-leaved forest	311	8632.31	64.27
9	Coniferous forest	312	107.16	0.8
10	Mixed forest	313	80.81	0.6
11	Natural grasslands	321	112.39	0.84
12	Transitional woodland-shrub	324	122.36	0.91
		Total	**13430.59**	**100**

The grasslands from ATU Vârfurile, framed in grasslands with High Natural Value - HNV (according to PNDR 2014-2020) occupy a total area of 1060.3 ha, respectively (7.9%) of the surface of ATU Vârfurile and are characterized by a high biodiversity (COJOCARIU ET AL. 2018). To these areas are added some lands included in the category "*Agricultural lands with natural vegetation*", which, over time, by abandonment, have been transformed into forested pastures.

Of the total area of Vârfurile commune (13430.59 ha), 1168.63 ha belong to the complex crops which include: annual mixtures and perennial mixtures, consisting of grasses and fodder legumes.

Figure 5 Plots of arable land alternating with other categories of land use

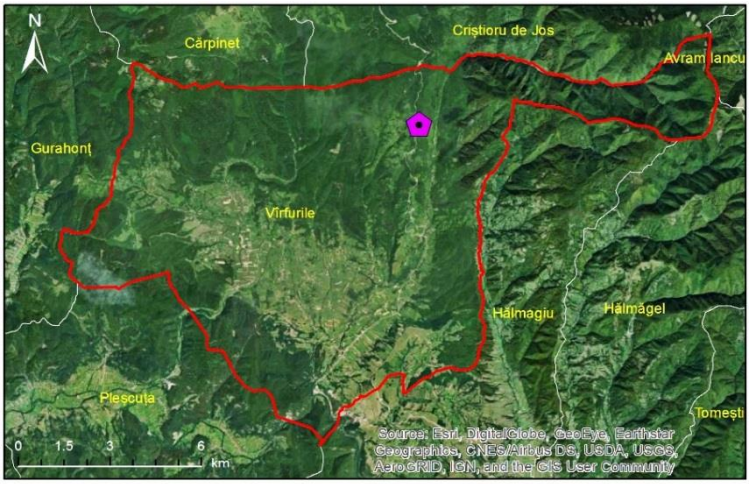
Being a predominantly hilly and mountainous area, the arable lands occupy small areas, 512.97 ha (3.82%), distributed in small plots, scattered among other categories of use, in low areas or on river valleys (Figure 5).

On small areas, alfalfa (*Medicago sativa* L.) red clover (*Trifolim pratense* L.), Birdsfoot trefoil (*Lotus corniculatus* L.) are cultivated for energy-protein feed (RADU ET AL. 2010; MAZĂRE ET AL. 2019; RECHIŢEAN ET AL. 2020) but also for capitalization in the form of hay. For the necessities of the households, rye, wheat and corn are also cultivated, on small and triticale surfaces. Early hybrids are used for corn, which bear fruit in a short period of time (BORCEAN ET AL. 2010).

Specific to the analyzed area are the protection curtains (trees and shrubs) that delimit the plots of arable land, meadows or complex crops. In the cadastral sense, these protective curtains are considered, in many cases, property limits.

The orchards, once in large areas, today occupy only 56.22 ha (0.42%), many of them being in pastures and falling into "traditional orchards", according to PNDR 2014 - 2020, for which subsidies are received.

According to PNDR 2014 - 2020, the HNV grasslands from ATU Vârfurile benefit from subsidies for feed losses through the Agri-environment and climate measure (Figure 6), being used in traditional systems.



*M10: P1 (P2.1, P2.2) – HNV grasslands; P4 - Green crops; P8 - Breeds of animals in danger of abandonment; M11: P1 - Crops on arable land; P2 – Vegetables; P3 – Orchards; P4 – Vineyards; P5 - Medicinal and aromatic plants; P6.2 - Permanent grasslands; M13-ZM: Mountain areas

Figure 6 Overlap of Measure M10 - Agri-environment and climate and M11 - Organic farming over ATU Vârfurile

In the study area is also subsidized ecological agriculture (Figure 6) practiced by the inhabitants of the commune in arable land, orchards, complex crops, permanent meadows, etc.

CONCLUSIONS

The territorial analysis shows that the largest share belongs to forests (8820.28 ha, respectively 65.67% of the territory) and grasslands with High Natural Value - HNV which occupies a total area of 1060.3 ha, respectively (7.9%) of the surface of the ATU Vârfurile, Arad county. The arable lands being distributed on small, generally fragmented areas occupy 512.97 ha (3.82%). In arable land, alfalfa, red clover, guinea fowl, triticale, rye and small areas with corn and wheat predominate among the agricultural crops.

In the analyzed area, sustainable agriculture is practiced, both in the extensive breeding of animals and in terms of cultivation technologies, the inhabitants benefiting from subsidies through the measure of Agro-environment and climate and ecological agriculture.

Efficient management includes, in addition to the optimal allocation of natural and human resources, the organization of production structures, the size of agricultural units, their cooperation systems, production forecasting and planning.

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