INVESTIGATION OF GRASSLANDS IN THE MOUNTAIN AREA THROUGH OPEN SOURCE SOLUTIONS. CASE STUDY

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Abstract. *The grasslands in the mountainous area of Romania are located in places that are difficult to access and therefore difficult to investigate through field studies; furthermore, the data collected in this way are punctual. As an alternative solution, there is the possibility of accessing Open Source data and software through which scientific information can be extracted from different spheres of research and continuous images can be obtained, over the entire surface of interest. In this context, the purpose of the research was to apply Open Source solutions for extracting "basic" information (location, delimitation and framing in the area, relief, geology, soils and so on) for the Ps Baru grassland, in the Tulişa mountains. The workflow was applied with Open Source software and data, taken from profile platforms and can be extended for any grasslands, regardless of their location or size. As a result of the research, it was found that: the grassland is located in the Tulişa Mountains, has an area of 309 ha and is surrounded by forest, which can be interpreted as an alarm signal about the risk of afforestation to which it is subjected. The grassland is located between 1200 - 1600 m altitude, and the relief is fragmented by the valleys of some rivers. Exploitation roads are present on the counter lines. Based on the longitudinal and transversal profiles, but also through the analysis of the generated relief maps, it was observed that the land slopes from the southwest to the northeast. In the subsoil of the analyzed grassland, the Tulişa Series and the Sebeş Series are predominantly present, and from a pedological aspect, two types of soil predominate, respectively districambosol and rendzin, on smaller surfaces. The use of Open Source data, for the characterization of grassland surfaces, offers a series of advantages: the possibility of using data sets of different types based on the complex characterization of the investigated surface can be done; free use of programs and data; the possibility of extracting the data without going to the field.*

Keywords*: grasslands, Open Source solutions, geospatial data, mountain area*.

INTRODUCTION

The phrase "Open Source" refers to data or programs made available to the public free of charge, software and data that can be modified or used without restrictions, with the obligation to specify their source. For the territory of Romania, there are multiple possibilities for information, visualization, access and extraction of geospatial data particularly useful in the characterization of grasslands. In this sense, the following can be mentioned: The Open Source Geospatial Foundation (OSGeo), a non-profit organization whose main mission is to promote the adoption of technologies focused on open geospatial data; the Geospatial platform through which concepts, techniques and tools specific to the geospatial community are explored, a platform where theoretical and practical materials (tutorials), geospatial datasets, maps and so on, can be consulted and downloaded for free. The European Environment Agency (EEA), an agency of the European Union, founded in 1994, provides data and scientific information, in particular, in the field of environment and climatology; the data.gov.ro portal provides users with open data sets delivered by public administration authorities and institutions, in various fields: agriculture, economy, environment, energy and so on; the space program of the European Union Copernicus, offers satellite information services (through satellite missions) and in-situ (non-spatial) data, relating to: atmosphere, climate change, land, vegetation, marine environment and so on.

Having access to the mentioned resources, any territory can be characterized under different aspects, based on several techniques, by the intended purpose (Simon et al., 2020). In the present case, in the study of grasslands, we took into account several essential parameters, both in the formation and evolution of the grassland surfaces, and in terms of the influence on the vegetation that settles and evolves on them (Moisuc et al., 1998). Thus, the relief, a direct and/or indirect factor, can influence the vegetation of the grasslands through the exposure of the slopes (Lieffering et al., 2019) or through the slope of the land (Bennie, 2003; Gonga et al., 2008; Lieffers and Larkin-Lieffers, 2011). Other factors, such as the geology and soils of the respective area, can leave their mark on the vegetation of the grasslands (Vetter et al., 2006). Also, especially in the case of grasslands in mountainous areas, the influence of climatic and anthropogenic factors is strongly felt (Blala and Zyszkowska, 2004; Iacob et al., 2015; Cojocariu et al., 2019).

The purpose of the research was to extract specific information and to characterize the grassland surfaces based on Open Source solutions, in which case the programs do not require a license, and the geospatial data are

available free of charge and without restrictions of use, on specialized platforms. As a case study, a grassland area located in the Tulișa Mountains, from the Retezat-Godeanu group of the Southern Carpathians, was selected. The information obtained in this way is used for the location and general description of the grasslands (mainly regarding the environmental factors), for the analysis of the neighborhoods and is the basis of future studies.

MATERIAL AND METHODS

1. Study area

The study area (Figure 1) is located in the Tulișa Mountains, a subunit of the Retezat Mountains (Posea and Badea, 1984; Rusu, 2007). From an administrative point of view, the analyzed grassland (Ps Baru) is located in the south of the administrative-territorial unit (ATU) Baru, in Hunedoara county. ATU Baru is bordered to the south by ATU Uricani and ATU Lupeni, to the east by ATU Bănita and ATU Petroșani, to the north by ATU Ortișoara de Sus and to the west by ATU Pui.

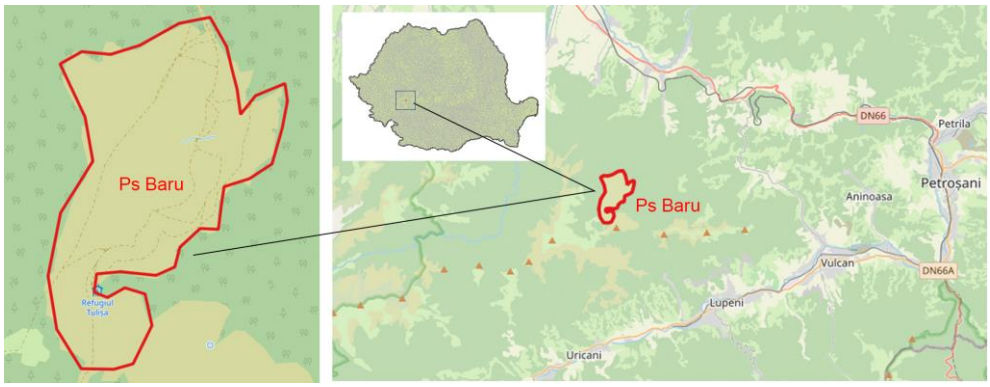

Figure 1. Localization in the area of the analyzed grassland, based on OSM Standard data

2. Research methodology

The research methodology regarding the complex analysis of the Ps Baru grassland area, through Open Source solutions, was based on the following workflow:

a. Localization in the area of Ps Baru - Open Source data available on the geospatial.org platform were used, respectively the ATU limits, the relief units of Romania (Geospatial, 2023), as well as the OSM Standard data set, imported into QGIS, through Quick Map Services (https://www.giscourse.com/quickmapservices-plugin-an-easy-way-to-add-basemaps-in-qgis/) (Figure 1);

b. Analysis of topographical details – the grassland plot was identified, delimited and subjected to the orthophotoplan of the area in Google Earth Pro; the longitudinal profile and the transverse profile of the grassland were made, based on which altimetric information was extracted, aspects related to the geomorphology of the area. For overall relief analysis, Ps Baru was overlaid in QGIS with the OpenTopoMap dataset, also included in the OSM dataset (https://www.giscourse.com/quickmapservices-plugin-an-easy-way-to- add-basemaps-in-qgis/). The result was the topographical map with contour lines and the 3D model of the Ps Baru surface;

c. The extraction of auxiliary information (geology and soils), as factors influencing the vegetation of grasslands - the Geological Map of Romania, scale 1: 200000, made by the Geological Institute of Romania and "digitized" by the Geospatial community and the Soil Map of Romania, scale 1:200000, were used (Geospatial, 2023).

In accordance with the main purpose of the study, namely the characterization of grassland surfaces through Open Source solutions, the work methodology was applied with Open Source programs, namely QGIS 3.24 and Google Earth Pro. The data sets used are available on specialized platforms and fall under the category of "free" data (ATU limits, county limits, geological map of Romania, etc ~~and so on~~).

RESULTS AND DISCUSSIONS

1. Analysis of topographic and relief details in Ps Baru

The Ps Baru grassland area was delimited and represented in Google Earth Pro (Figure 2), a platform in which the area of 309 ha and the perimeter of 9671 m were automatically determined. The overlap of the area of interest with the orthophotoplan highlights the fact that the grassland is bordered of forest areas, in the north, west and east, and in the southeast part, it is bordered by another grassland area (Figure 2). The fact that the

grassland is surrounded by forest can be seen as an alarm signal about the risk of afforestation to which it is subjected.

Superimposing the surface of grasslands with the orthophotoplan (faithful image of the reality in the field), its general appearance, the presence of shrub formations, roads, gaps in the vegetation or the possibility of the existence of invasive vegetation can be analyzed (Figure 2).

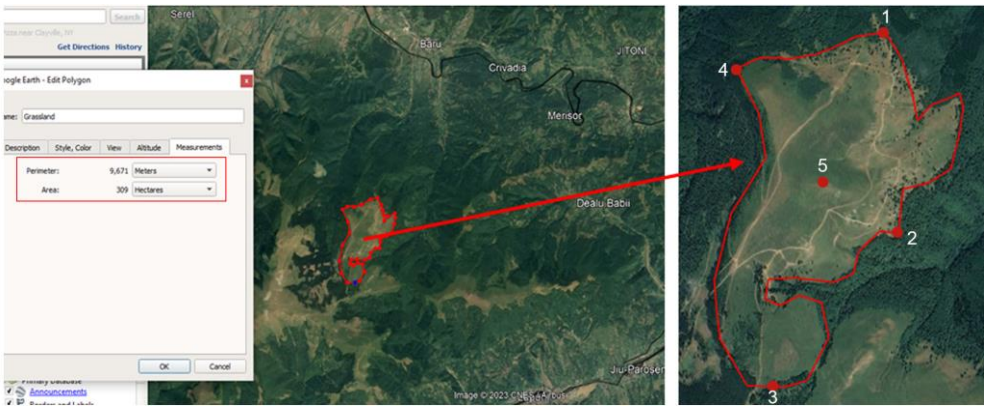

Figure 2. The location on the orthophotoplan of Ps Baru, in Google Earth Pro

From Google Earth Pro, the contour of the plot was exported as a .kmz file and imported into QGIS, as a .shp file, in this file the geographic coordinates of the extreme points and the central point (Table 1) were extracted, as an element of identification and localization of the Ps Baru plot.

Table 1. Geographic coordinates of Ps Baru

Point	Latitude	Longitude
1	45°25'14.812"N	23°8'39.944"E
2	45°24'18.304"N	23°8'43.080"E
3	45°23'41.038"N	23°7'59.646"E
4	45°25'2.382"N	23°7'43.297"E
5	45°24'32.729"N	23°8'17.431"E

Longitudinal and transversal profiles were drawn on the Ps Baru grassland plot in Google Earth Pro (Figure 3, Figure 5). They provide information about the conformation of the relief, altitude and slope (Figure 4, Figure 6), particularly important elements in the study of grasslands.

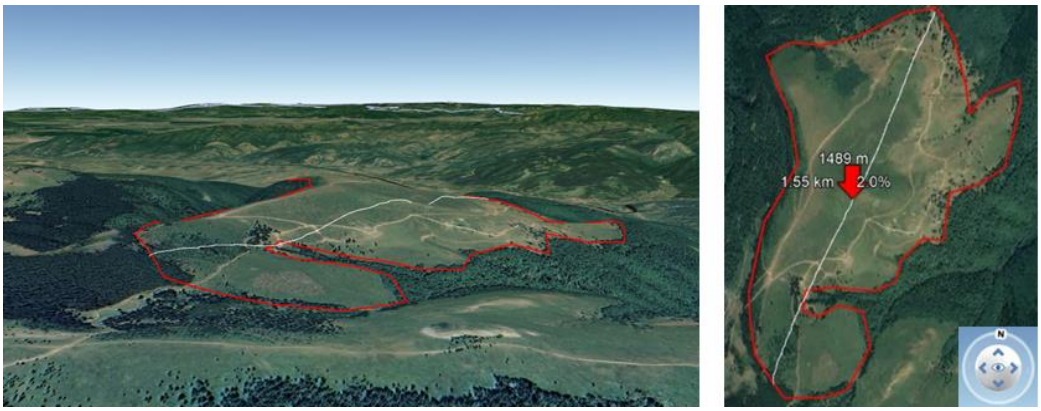

Figure 3 Longitudinal profile in Ps Baru

In the longitudinal profile, in the north-south direction (Figure 3, Figure 4), it can be seen that the altitudes increase from north to south, the maximum elevation being 1541 m, and the minimum, 1296 m. Along the length of the longitudinal profile of 3.03 km, (Figure 4) there is a peak around the altitude of 1488 m (1.5 km in profile) and another lower peak of 1427 m in height, after which the elevation drops to the value of 1296 m.

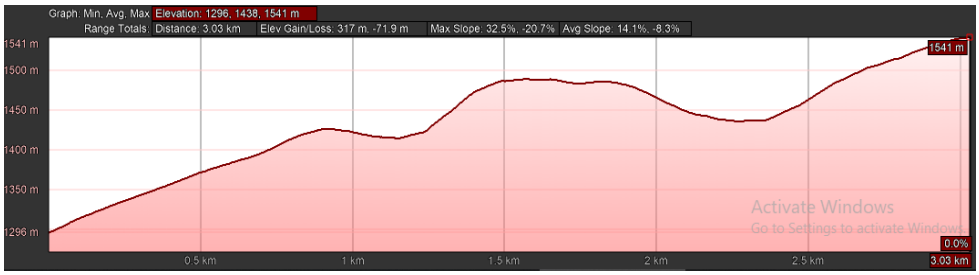

Figure 4 Graphic representation of the longitudinal profile in Ps Baru

In the transverse profile, the altitude of the area of interest increases over a profile length of 168 m, from 1503 m, up to the maximum value of 1535 m and then decreases constantly from west to east (Figure 5, Figure 6), until at the altitude of 1332 m. The total length of the transverse profile is 1.22 km.

Figure 5 Transverse profile in Ps Baru

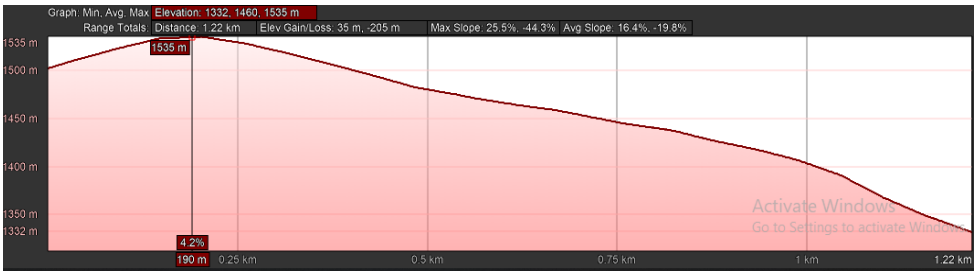

Figure 6 Graphical representation of the transverse profile in Ps Baru

For relief analysis, the overall grassland surface contour was imported as a .shp file into QGIS and overlaid with the OSM Standard dataset. In the resulting map (Figure 7) it can be seen that the pasture is framed between the main contour line of 1200 m and 1600 m, and the relief is fragmented by the valleys of some rivers. Exploitation roads are present on the contour lines.

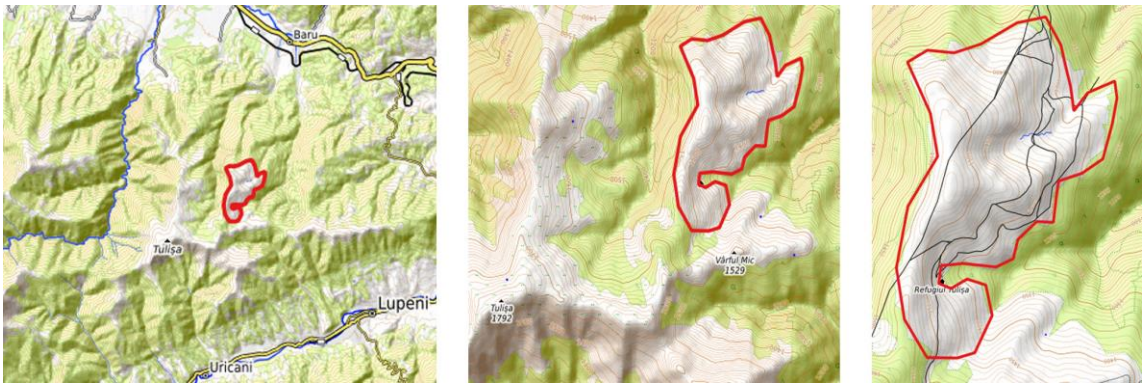

Figure 7. Topographical details of the Ps Baru (processing according to OSM Standard)

In general, the land is fragmented and slopes from southwest to northeast, which is also found in the types of vegetation.

Taking into account the appearance of the relief expressed by the contour lines, certain hypotheses can be deduced related to the manifestation of slope processes (surface or deep erosion, landslides), of wind erosion phenomena or of restrictive climatic conditions (low temperatures, high amounts of precipitation), the area being located at over 1200 m altitude.

2. Analysis of geological and pedological data for Ps Baru

For the analysis of the geology of the considered grassland, the overlap was made with the Geological Map of Romania, scale 1:200000 (Figure 8). It was found that the subsoil of the analyzed area is made up of the Sebeș and Rapolt epimetamorphic series, the Drăgșan series and the Lainici-Păruș series, in the eastern part, consisting of Retezat granitoids, chlorite-sericitous schists, amphibolites, biotitic gneisses, quartzites, crystalline limestones and so on (Urdea and Cheslerean, 1997).

Figure 8 Geological map - Ps Baru (processing after Geospatial, 2023)

The Tulișa series, present in the largest proportion of the analyzed territory, is represented by clays, sandstones, conglomerates, Oslea limestone and so on (Urdea and Cheslerean, 1997).

In order to identify the soils in the area of interest, the outline of the analyzed grassland was superimposed on the Soil Map of Romania (Figure 9). The soil units at the type level, expressed in the database according to SRCS 1980, were equated according to SRTS 2012 and WRB-SR 2006 (Florea et al., 2012; Țărău et al, 2012). It was thus found that two types of soil predominate on the respective surface, respectively districambosol and rendzin, on smaller surfaces.

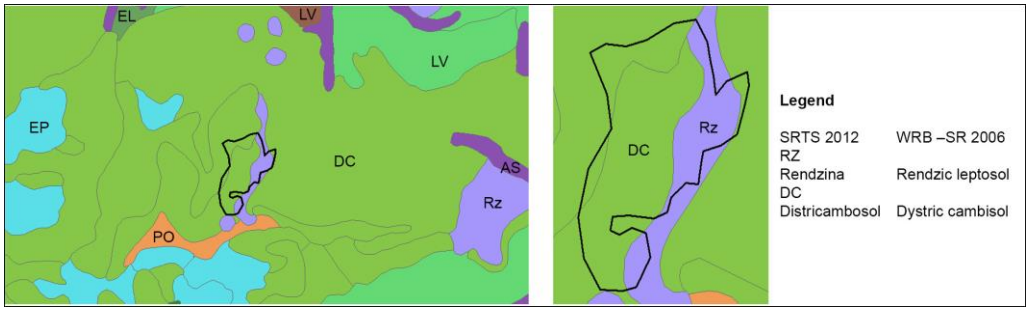

Figure 9 Soil map - Ps Baru (processing after Geospatial, 2023)

Districambosols are specific to altitudes above 1000 m, having a wide distribution in the Carpathians (Ilie and Mihalache, 2019), acidic soils on which secondary pastures with *Nardus stricta* and *Festuca rubra* can be established. Rendzins grow on calcareous rocks, from the plains to the mountains, they are soils with high fertility, but they have a short profile, ~~and~~ rich in skeletal material (Țărău and Dicu, 2014).

CONCLUSIONS

The Ps Baru grassland, with an area of 309 ha, located in the Tulișa Mountains, is a complex area from a physical-geographical point of view, which is also reflected in the distribution and typology of the vegetation.

Through Open Source solutions, it was possible to extract a large volume of information for the general characterization of the analyzed grassland, under different aspects: location and "physical aspect" (shape, surface, perimeter), relief peculiarities, geology and soils. This information can also be used in further studies on grassland vegetation.

The use of Open Source data, for the characterization of grassland surfaces, offers several advantages, among which can be mentioned: the possibility of using data sets of different types (relief, geological, pedological data and so on) based which it can be made the complex characterization of the investigated surface; free use of programs and data; the possibility of data extraction without traveling to the field. Constraints in using Open Source data for grassland analysis are related to the resolution of freely available data; their average resolution cannot support a large-scale analysis, with a very high degree of detail of the reality on the ground.

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