INFLUENCE OF ENVIRONMENTAL FACTORS ON THE BEGINNING OF GRAZING ON GRASSLANDS FROM ATU ORAVIŢA, IN CORRELATION WITH PASTORAL TRADITIONS

Lia HOANCEA[1], M. SIMON[1], P. RAIN[1], Loredana COPĂCEAN[1], Luminiţa COJOCARIU[1,2]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, 300645, 119, Calea Aradului, Timisoara, Romania
[2]Centre for Mountain Economics, "Costin C. Kiritescu" National Institute for Economic Research, Romanian Academy, Academy House, Calea 13 Septembrie Nr. 13, Sector 5, Bucureşti, Romania
Corresponding author:luminitacojocariu@yahoo.com

Abstract. *Banat area, from Romania, maintains its old pastoral traditions, of which some are from the Dacians and Romans' period. In the Administrative Territorial Unit (ATU) Oraviţa, Caraş – Severin County, the material space, in direct relationship with the religious one, has been crystallized and evolved in strong connection with the relief conditions (the contact between the mountain and the depression area) and the major production activities (animal breeding), which generated a lifestyle specific to the inhabitants of this area. In this perspective, the pastoral year, according to their own calendar, begins with the Christian celebration of Saint George (23rd of April) and ends with Saint Demetrius (26th of October), the opener of the pastoral winter.Under such circumstances, this paperwork attempts to identify the opportunity of maintaining the pastoral traditions related to the beginning of grazing on grasslands from ATU Oraviţa, identified by GIS techniques and teledetection. In order to carry out this study, we also used the data and scientific information provided by the specialty literature regarding the beginning of grazing, data from the Meteo Station Oraviţa (2015-2017), and also data achieved through direct observations, in field. According to temperature variation during March, April and May, the areas of temperature representation for 2016 and 2017 increase compared to 2015, and this reveals the fact that, in 2015, when the temperatures overtake for 10 days an average value bigger than 10 degrees (necessary for plant growing) is comprised within the middle of April, and this corresponds to the beginning of the traditional pastoral year. Meanwhile, in 2016, the corresponding period is comprised between 28th of March and 6th of April, and, in 2017, this period is comprised at the end of March, namely 20th – 29th of March. During this period, the rainfall favours, beside temperature, plant growing in the grasslands analyzed. The Romanian people has created its own calendar, deeply anchored in religion, meteorology, traditions and beliefs reflected in the relationship between traditional activities and nature rhythms, a symbol of maintenance of our cultural identity, by preservation and capitalization of the popular ethos.*

Key words: *temperature, rainfall, grassland, pastoral traditions*

INTRODUCTION

The Banat area, from Romania, occupies an area of 18936.39 km^2, respectively 1893639 ha, of which 20% is the semi-natural meadows arranged on altitude levels [4]. Especially in the Mountain Banat, the old pastoral traditions, some of which date back to the Dacians and Romans, are still preserved today as a symbol of our cultural identity [10].

Depending on the level of material and spiritual development of the society, in relation to climatic conditions, geographical latitude and longitude, the inhabitants of the Romanian pastoral area invented "monthly, solar and solar-lunar calendars" [2, 5]. Thus, the "practical agricultural calendars" also appear, like the pastoral calendar in which both the beginning (April 23 – St. George) and the end of the pastoral year (October 26 - St. Demetrius) are marked [8, 9, 12], as well as the most important pastoral activities reported at seasonal

holidays. Since sheep and cattle breeding is carried out at other biological rhythms than the vegetal ones, pastoral celebrations were displaced a month later with equinox and solstice in the old Julian calendar and the new Gregorian calendar [5].

As a fixed date in the popular calendar and Orthodox Christian calendar, the feast of St. George on April 23rd marks the opening of the warm, living time of the year [7]. From now on, spring is starting in the new pastoral year, considering that the climatic factors in April favour the growth and development of grass, the greening of trees and plants with "miraculous powers" that adorn the houses and animal stables. In this context, the paper proposes, on the basis of the analysis of the climatic factors in March, April and May in the analyzed area, to mark the moment of entry with the animals on the identified pastures (by GIS techniques) correlated with the beginning of the pastoral calendar (April 23rd), preserved over time in the tradition of the people.

MATERIALS AND METHODS

Study area

The study area is located in the South-West of Caras-Severin County and South-West of Romania (Figure 1), with a total area of 16080.39 ha [17].

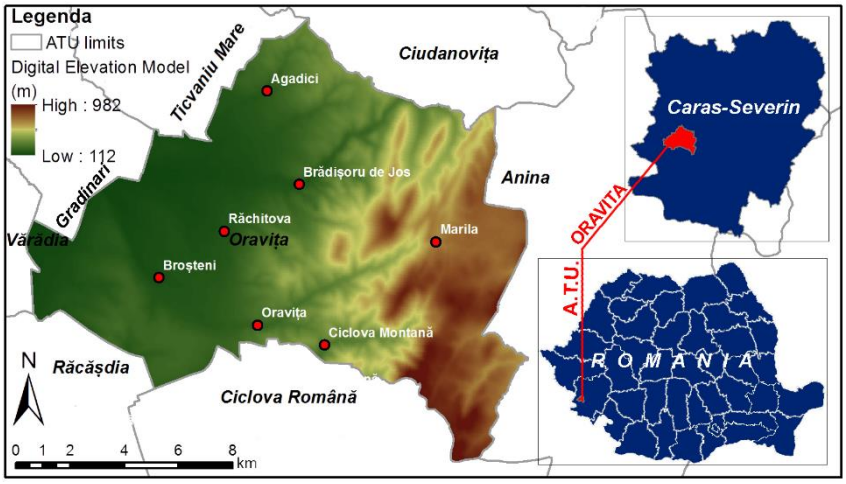


Figure 1 Location of study area (processing after [16, 19])

In the Banat Mountains, the average multiannual temperature ranges between 3.7 - 12.6°C, amid a various relief with high amplitude (Figure 2). In the analyzed area, the multiannual average temperature over the last 10 years is 12.8°C.

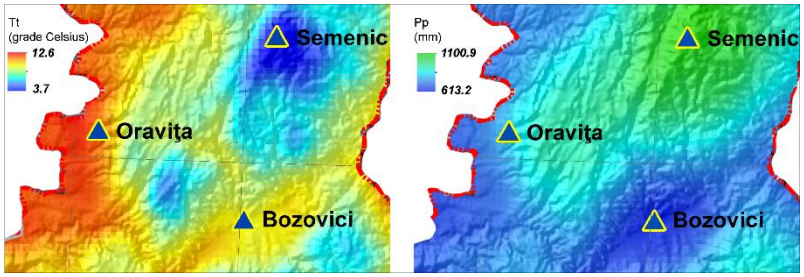


Figure 2 Air temperature (Tt) and multi-year average rainfall (Pp) in the Oravița area [11]

The average annual rainfall in the Banat Mountains varies between 613.2 - 1100.9 mm, also distributed according to the characteristics of the relief. In the area of study, over the past 10 years, a 7782 mm rainfall has been recorded, with annual amounts generally a bit more than 800 mm.

Types of data used:

- Meteorological measurements (thermal and pluviometric values) from the Oravița meteorological station from 2015 to 2017 [18]
- Geospatial data - The Digital Elevation Model (DEM), the boundaries of the administrative-territorial units, the boundaries of the counties and the borders of Romania, the use of the land [16, 17, 19]
- Data and information from the literature on pastoral traditions, peculiarities of the study area, etc.

The study methodology is schematically described in Figure 3.

STAGE 1	**Identification of grassland areas**
	Corinne Land Cover Database
STAGE II	**The correlation of the grasslands - altitude - vegetation**
	Digital Elevation Model
	Vegetation studies
STAGE III	**Establishing the optimal time for the beginning of the grazing season**
	Average daily temperatures between March and May

Figure 3 Working methodology and materials used

The Corinne Land Cover database, 2012 edition, was used ***to identify the grassland areas***. The categories *"natural grasslands"* and *"secondary pastures"* have been selected (code 231, 321).

The altitude-grassland correlation was made on the basis of the Digital Elevation Model with a 25 m spatial resolution. The grasslands were grouped on 100 m altitude levels *(areal spatial analysis - TabulateArea)*. Vegetation studies have been carried out on the basis of vegetation surveys; only a synthesis is presented in the paper.

The optimal moment for the ***start of the grazing season versus the beginning of the traditional pastoral year*** was established on the basis of the climatic data recorded at the

Oraviţa meteorological station, i.e. daily average temperatures in March, April and May, for the years 2015 - 2017.

For statistical processing of geospatial data and the generation of graphic and cartographic materials (thematic maps), the ArcGIS 10.2.1 software was used and methodologies described in the literature [1, 3, 20].

RESULTS AND DISCUSSIONS

At the level of the Oraviţa administrative-territorial unit, the grasslands are located in the Western half; the Eastern part of the territory, the mountain area, is covered by forests (Figure 4).

The grasslands of the analyzed area have a high biodiversity, with several associations and grasslands depending on altitude, slope, exposure and management.

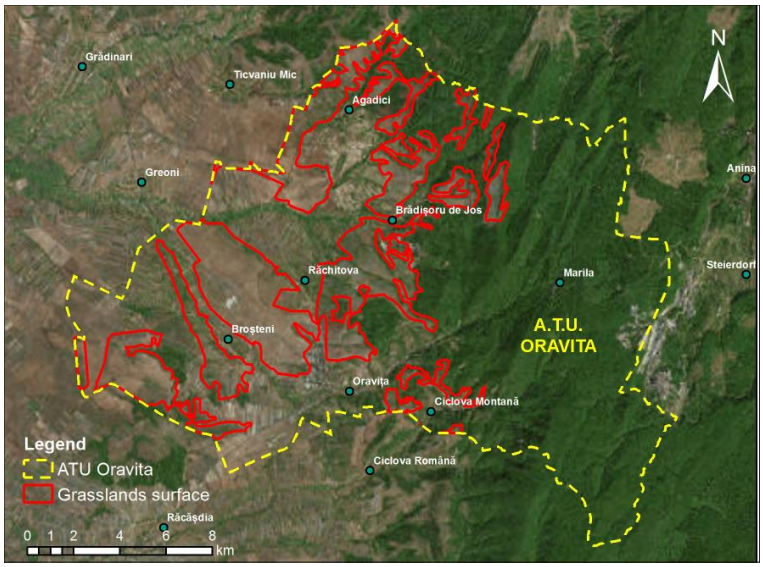


Figure 4 The repartition of the grassland areas in the A.T.U. Oraviţa [16, 17]

The grasslands (pastures and hayfields) amount to 3842.54 ha, which represents 23.9% of the total area.

By analyzing the grasslands in "vertical plane", we observed their placement in low areas, below 600 m (Figure 5). From the point of view of the vertical distribution of grasslands in the area of interest, they fall into the category of hills and high plateaus belonging to Banat Hills, these hills being grouped in the subdivision called Oraviţa Hills [14]. Depending on their natural production capacity and use, the following grassland formations are distinguished in the analyzed area:

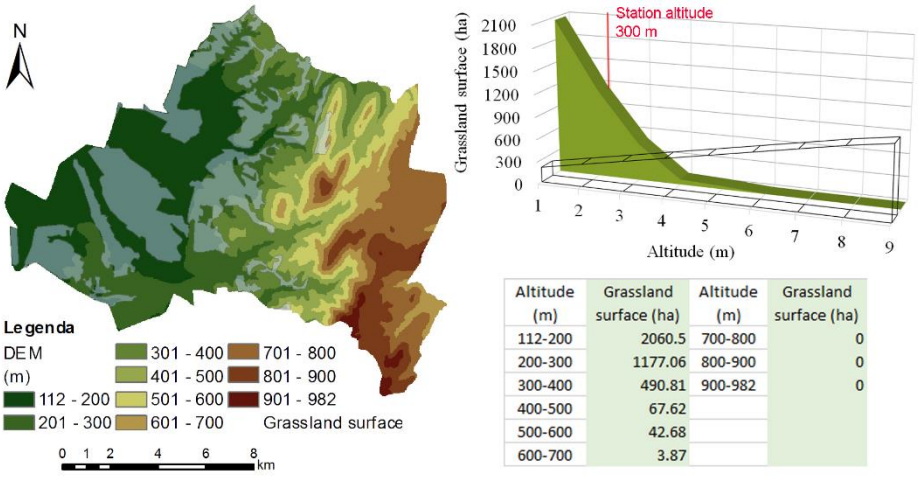
- productive, mesophilic medium hilly pastures with a mediocre to good nutritional value, where *Lolium perenne*, *Cynosurus cristatus* and various clover species predominate;
- low-productive meadow pastures, mezo-xerophilous, with low to mediocre nutritional value, with *Festuca valesiaca*, *Botriochloa ischaemum* and few forage legumes predominating;

- mezotermophilic medium-productive hill grasslands with a mediocre nutritional value, for one mowing, dominated by the species *Agrostis tenuis*; varieties of *Festuca* sp. are codominant;

- low-productive hay meadows, mezoxerophilous xerophilus, for one mowing, of low nutritional value, dominated by the *Chrysopogon gryllus* species.

According to Figure 5, most of the grassland areas are concentrated below the altitude of 300 m (about 85%).

Considering that the grassland areas are located at altitudes not exceeding 600 m, their climatic characterization may objectively rely on the climatic data recorded at the Oravița meteorological station, situated at an altitude of 309 m.



Altitude (m)	Grassland surface (ha)	Altitude (m)	Grassland surface (ha)
112-200	2060.5	700-800	0
200-300	1177.06	800-900	0
300-400	490.81	900-982	0
400-500	67.62		
500-600	42.68		
600-700	3.87		

Figure 5 Vertical distribution of grassland areas in ATU Oravița

The grasslands within the ATU Oravița located on the altitude level of 112 - 700 m, with diverse natural conditions, are used for grazing with sheep, less cattle, or mowing [15]. Overall, the grasslands are less grazed, and only some care is being done. In this situation the production of grasslands was between 1.2 - 1.9 t.ha^{-1} DM (dry matter), under the production capacity.

The influence of temperature on the beginning of the grazing (pastoral year)

The analysis of climatic conditions in the experimental period 2015 - 2017 shows their fluctuating nature. During the analyzed time, rainfall is well distributed both during winter and at the end of the winter, favouring the growth and development of the plants in the grasslands analyzed. Instead, the temperatures in February, March, April and May oscillate from one year to the next, and there is a decisive influence on the starting of the grassland species in vegetation.

A series of researches in the field [8, 13] highlight the fact that grazing starts when the dominant species in the grassland have reached a height of 6-10 cm. Depending on the grassland type, these values are recorded when the temperatures exceed 10°C within 10 calendar days [6] against the background of a suitable humidity.

In the temperature variation graphs (Figure 6), we may observe that the areas of representation of the temperatures for the years 2016 and 2017 are increasing compared to those of 2015, which highlights the fact that:

- in 2015, when the temperatures exceed for 10 days an average of more than 10 degrees is in mid-April; while in 2016, the corresponding period is between March 28th and April 6th, and in 2017 at the end of March, namely March 20th and March 29th.

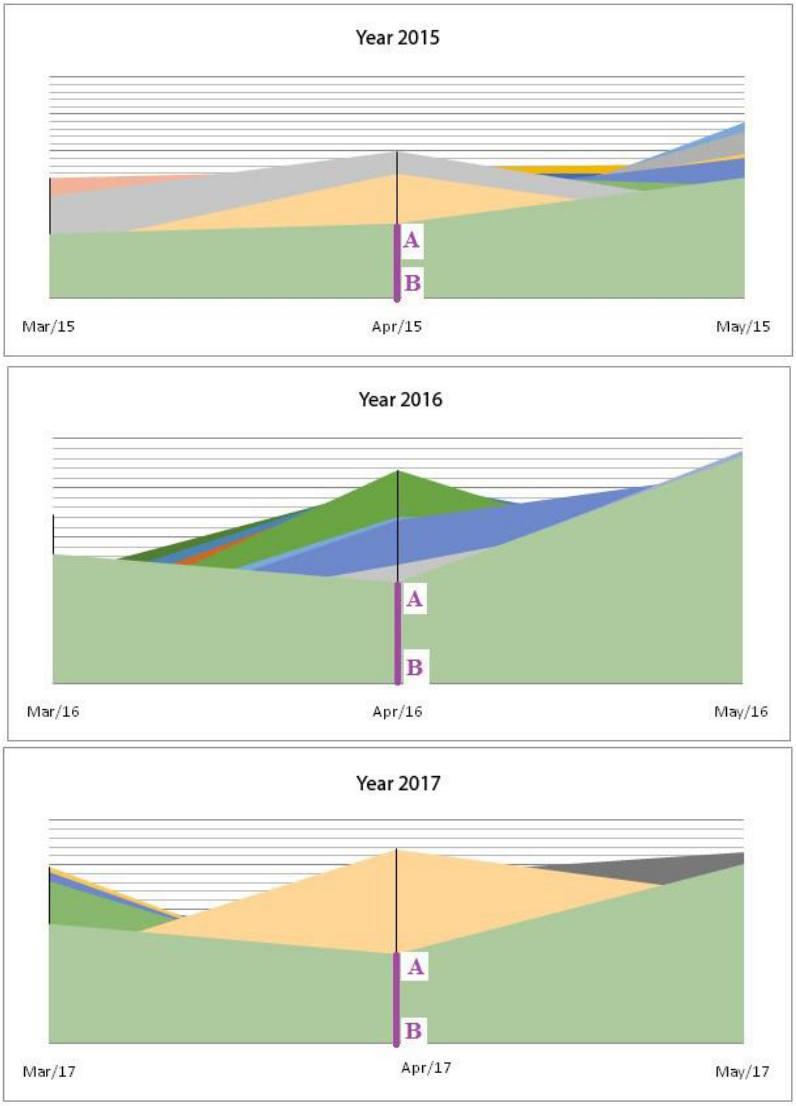


Figure 6 Temperature variations between March and May (2015-2017) at the Oraviţa weather station (processing after [18])

The fact that the climatic conditions of 2016 and 2017 are advancing the beginning of the grazing in late March is not isolated over time, this aspect being superposed on the 25th of March "Christian Annunciation". In the folk tradition, this holiday is a "decisive moment of the awakening of life" [7].

CONCLUSIONS

At the level of administrative-territorial unit Oravița, the grasslands amount to an area of 3842.54 ha and are situated on the altitude level of 112 - 700 m. The grasslands are under-grazed and only some care is done; their efficiency is below the production capacity.

The moment of beginning grazing on grasslands in the area analyzed is very much influenced by the climatic conditions of the year. Rainfall is not a limiting factor. Instead, the average monthly temperatures of the year can have a decisive influence on the growth and development of the grassland vegetation.

Thus, in 2015, the period when the temperatures exceed for 10 days a value bigger than 10 degrees is 9-18 April, so animals can enter grasslands for grazing after 18 April; somehow, this corresponds to the beginning of the traditional pastoral year. In 2016, this can take place after April 6th, two weeks earlier than in the previous year, and in 2017 after March 29th, much earlier than in previous years.

The Romanian people created their own calendar, profoundly anchored in religion, meteorology, customs and beliefs reflected by the link between the traditional activities and the rhythms of nature, a symbol of preserving our cultural identity by preserving and capitalizing the popular ethos.

BIBLIOGRAFIE

[1] BÂRLIBA LUMINIȚA LIVIA, BÂRLIBA C, ELEȘ G, Computing and verifying the land surface without visibility by using GPS and classic procedures, SGEM 2013, Conference Proceedings, Vol.I, 355-362, ISSN 1314-2704, ISBN 978-954-91818-9-0.

[2] BERNEA E., Spaţiu, timp şi cauzalitate la poporul român, reeditat Ed.Humanitas, Bucureşti, 1997

[3] BOULOS MN., Web GIS in practice III: creating a simple interactive map of England's Strategic Health Authorities using Google Maps API, Google Earth KML, and MSN Virtual Earth Map Control. Int J Health Geogr 2005, 4:22.

[4] COJOCARIU LUMINITA, BORDEAN DESPINA-MARIA, COPACEAN LOREDANA, HOANCEA LIA, Evaluation of the biodiversity protection degree in Romanian Banat by geomatic methods, SGEM 2018, Conference Proceedings, Vol.18, ISSUE 5.1. pp 369-376, https://doiorg/10.5593/sgem.2018/5.1, 2018

[5] GHINOIU I, Sărbători şi obiceiuri româneşti, Editura Elion, Bucureşti, 2003

[6] HOANCEA LIA, COPACEAN LOREDANA, BORDEAN DESPINA MARIA, COJOCARIU LUMINIȚA, SGEM 2018, Conference Proceedings, Vol. 17, Issue 52, 33-40 pp, DOI: 10.5593/sgem2017/52/S20.005, 2018

[7] LAPTEȘ MARCEL, Anotimpuri magico-religioase, Schițe etnografice, Editura Corvin Deva, 2011

[8] MARUȘCA T.,VASILE A. BLAJ, RUSU MARIANA, Tehnologii de creștere a valorii pastorale pentru pajiștile montane, 2012, on-line at: http://pajisti-grassland.ro/proiecte/lucrari/brosura_tehnologii.pdf ;

[9] OLTEANU ANTOANETA, Calendarele poporului român, editura Paideea, București, 2001

[10] RUSU, R. Organizarea spaţiului geografic în Banat, Editura Mirton, Timișoara, 2007

[11] SĂNDOIU I, Evaluarea plasticităţii ecologice a speciei *Agrostis Capillaris* L în arealul Munţilor Banatului, Timișoara, 2018, Teză de doctorat

[12] SĂVOIU GH., STANCIU MIRELA, VLAD I, The pastoral activities' and the religious calendar in the only one wood art piece called „răboj", Simpozionul "Valorificarea resurselor naturale și

antropice ale satelor pastorale din zona montana", Sibiu 26 noiembrie 2010, pg. 7-18, on-line at:www.atmh.ro/download/volumulsimpozionului.pdf;
[13] WRIGHT, I., JONES, J., DAVIES, D., DAVIDSON, G., & VALE, J., The effect of sward surface height on the response to mixed grazing by cattle and sheep. Animal Science, 82(2), 271-276. doi:10.1079/ASC200517, 2006
[14] ••• Geografia României, vol. IV, Regiuni pericarpatice, Ed. Academiei române, București, 1992
[15] http://www.agrinet.ro/content.jsp?page=320&language=1
[16] http://www.geo-spatial.org/download/romania-seturi-vectoriale
[17] https://land.copernicus.eu/pan-european/corine-land-cover/clc-2012
[18] https://rp5.ru/Vremea_%C3%AEn_Oravi%C5%A3a
[19] https://www.eea.europa.eu/data-and-maps/data/eu-dem
[20] http://desktop.arcgis.com/en/arcmap/10.3/main/get-started/arcgis-tutorials.htm