ANALYSIS OF THE DYNAMICS OF GRASSLANDS IN THE MOUNTAIN AREA OF BANAT. CASE STUDY

Margareta MĂGUREANU[1], Loredana COPĂCEAN[1], Luminiţa COJOCARIU[1]

[1]University of Life Sciences „King Mihai I" from Timisoara,
119, Calea Aradului, 300645, Timisoara, Romania
Corresponding author: luminitacojocariu@yahoo.com

Abstract. *In the land fund of the mountainous areas, implicitly of the Banat Mountains, forest areas predominate and in high proportions the areas used as grasslands. Over time, under the influence of natural and/or anthropogenic factors, grasslands undergo changes in terms of the occupied surface. In this context, the main purpose of the paper is to analyze the changes in grassland areas between 1990 and 2018, based on the land cover/land use data available in the form of the Corine Land Cover database, editions 1990, 2000, 2006, 2012 and 2018. As a case study, the Teregova administrative-territorial unit was selected, with an extensive surface and representative for the mountain area of Banat. The vector data, respectively the graphic representation of the grassland surfaces, were processed in the ArcGIS 10.4 software. After processing, the two sets of data from the years 1990 and 2018 were compared to determine the changes produced. For a detailed analysis of the changes, the Land Change Modeller module was used, implemented in the TerrSet software, through which it is possible to follow the transformations in other ways of land use, the "migration" of land from one class to another, but also the increases or surface losses, within the same category of use. The research results show the mobility of the land use categories, in the analyzed time interval, by decreasing and/or increasing the surfaces for different land use categories, which may suggest the development of new strategies for managing the respective space.*

Keywords: *land use, grasslands, GIS, change detection*.

INTRODUCTION

For rural areas and especially in the economy of mountainous areas, grasslands represent a particularly important component in that they constitute a source of income for the inhabitants of these areas (BROOM ET AL, 2013). On the other hand, grasslands are of major importance in terms of biodiversity, being composed of numerous plant species of high biological value (BAKKER, BERENDSE,1999; AKEROYD, PAGE, 2011; COJOCARIU ET AL, 2018; NITA ET AL, 2019).

Over time, due to some natural factors or as a result of some social, economic or political actions, changes occur in the structure of the land fund and in the way the land is used. These changes can produce effects in the respective areas, which are reflected both in the maintenance of local balances and on future development processes.

Currently, the spatio-temporal dynamics of the land fund and implicitly the way the land is used, can be monitored by geomatic techniques and means, based on pre-existing geospatial data sets or by processing aerial and satellite images, from different sensors (GHOSH ET AL, 1996; SHALABY, TATEISHI, 2007; BĂLTEANU, POPOVICI, 2010; PRAKASAM, 2010; COJOCARIU ET AL, 2015; TARANTINO ET AL, 2016; CEGIELSKA ET AL, 2018; SIMON ET.AL, 2018; COPĂCEAN ET AL, 2019).

One of the possibilities for analyzing and monitoring land cover/land use, in the geomatics environment, is the Corine Land Cover data collection, available at European level, in the form of five vector data sets, for different years. These geospatial databases are used differently, depending on the research objectives (POPOVICI ET AL, 2013; MISHRA ET AL, 2014;

HANGANU, CONSTANTINESCU, 2015; MEHRABI ET AL, 2019; KHOSHNOOD MOTLAGH ET AL, 2021).

In this context, the main aim of the paper is to analyze the changes in the grassland areas, in the period 1990-2018, based on the land cover/land use data available in the form of the Corine Land Cover (CLC) database, editions 1990, 2000, 2006 , 2012 and 2018. As a case study, the Teregova administrative-territorial unit (ATU) was selected, with an extensive surface and representative for the mountain area of Banat.

MATERIALS AND METHODS

Study area

As a study area, the Teregova administrative-territorial unit, from Caraş-Severin county, a complex area from a physical-geographical point of view (POSEA, 2005), was selected, considering its location in several relief units, thus (POSEA, BADEA, 1984; GEOSPATIAL, 2022):

- in the central part, with the lowest altitudes (Figure 1), the Timiş-Cerna Corridor, with the Caransebeş and Mehadica Depressions;
- in the south-western part, the Semenic Mountains and in the north-west, their subunit the Gărîna Depression, from the Banat Mountains Group;
- in the north-eastern part, the Ţarcu Mountains and in the south-eastern part, the Cernei Mountains, from the Southern Carpathians.

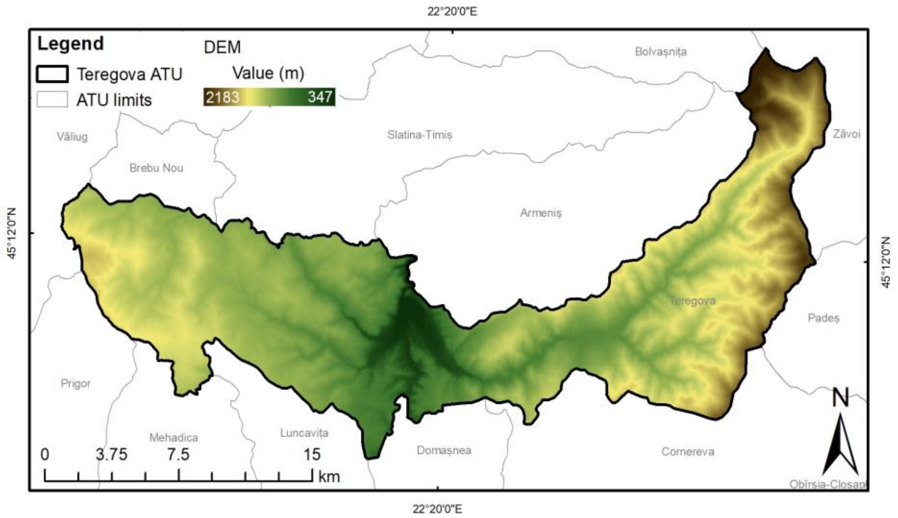


Figure 1 Location of the study area (processing after GEOSPATIAL, 2022; EEA - EU-DEM, 2022)

From an altimetric point of view, the study area falls between 347 m, in the central, depressional area and 2183 m, in the north-eastern part, in the Ţarcu Mountains (Figure 1).

Research methodology

The research was carried out according to the work scheme from figure 2.

a. Data processing in ArcGIS, involved the processing of geospatial data, thus (ARCGIS DOCUMENTATION, 2022):

- the study area was extracted, on the border of ATU (ANCPI, 2022);

- the study area was extracted from the five CLC data sets, for the years 1990, 2000, 2006, 2012 and 2018 (COPERNICUS LAND MONITORING SERVICE, 2022);
- the land use classes in the five CLC datasets were restructured as follows: Built space (112); Arable land (211); Fruit tree plantations (222); Complex crops and pastures (231(; Forest areas (311); Shrubs (324); Areas without vegetation (332);
- CLC data conversion, from vector format to raster and ASCII format, for import into TerrSet software;
- extraction and processing of the Digital Elevation Model (DEM), with a spatial resolution of 25 m (EU-DEM, 2022) for the area of interest;

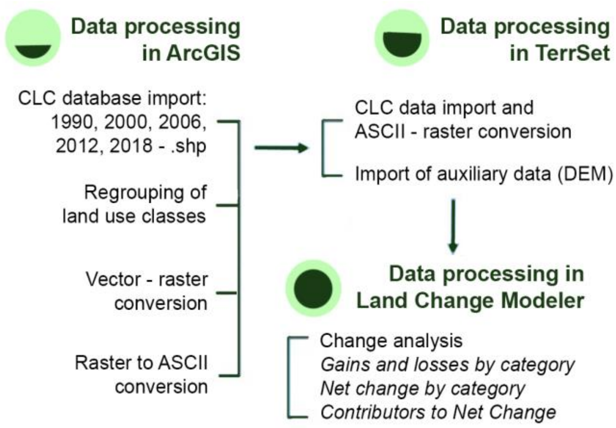


Figure 2 Work methodology

b. Data processing in TerrSet (EASTMAN, 2016), involved the import and conversion in .rst format, both of the land use data, for the years 1990 and 2018, and of the auxiliary data, respectively the Digital Elevation Model;

c. Data processing in Land Change Modeler, environmental analysis tool implemented in TerrSet; the land use data from the years 1990 and 2018, the beginning and end of the analyzed time interval, were entered, in order to highlight (EASTMAN, 2016):

- the changes produced by surface increases and reductions, by classes of use;
- the net changes within each class;
- the contribution to the net changes.

RESULTS AND DISCUSSION

Land use between 1990 and 2018

The way the land is used, at the level of the Teregova commune, can be considered an expression of the physical-geographical conditions, the relief, through altitude, slope and the orientation of the slopes, "dictates" the characteristics of the vegetation cover (BENNIE, 2003; GONGA ET AL, 2008; LIEFFERS, LARKIN-LIEFFERS, 2011; LIEFFERING ET AL, 2019) and implicitly the way of land management and use. In the depression areas, the lands are used for agriculture (arable land, pastures, complex crops etc.) and in the mountain areas, forests, lands covered with shrubs vegetation and lands devoid of vegetation predominate (Figure 3).

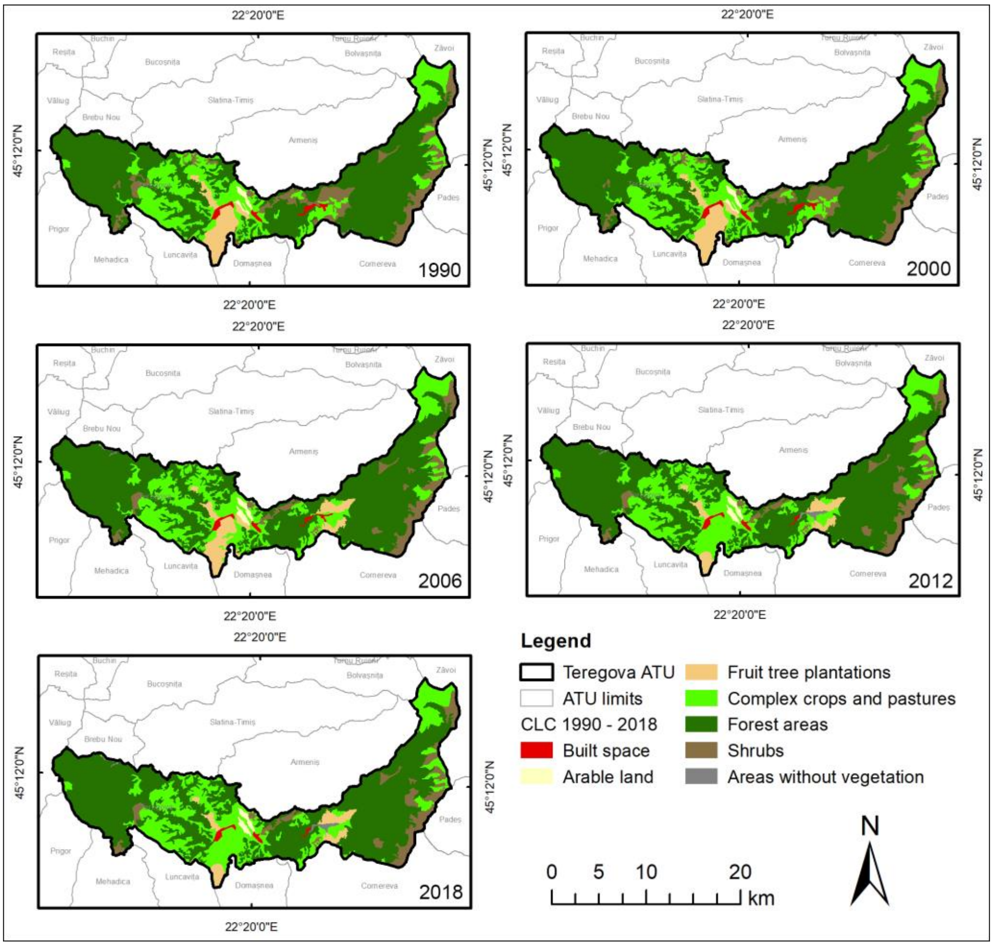
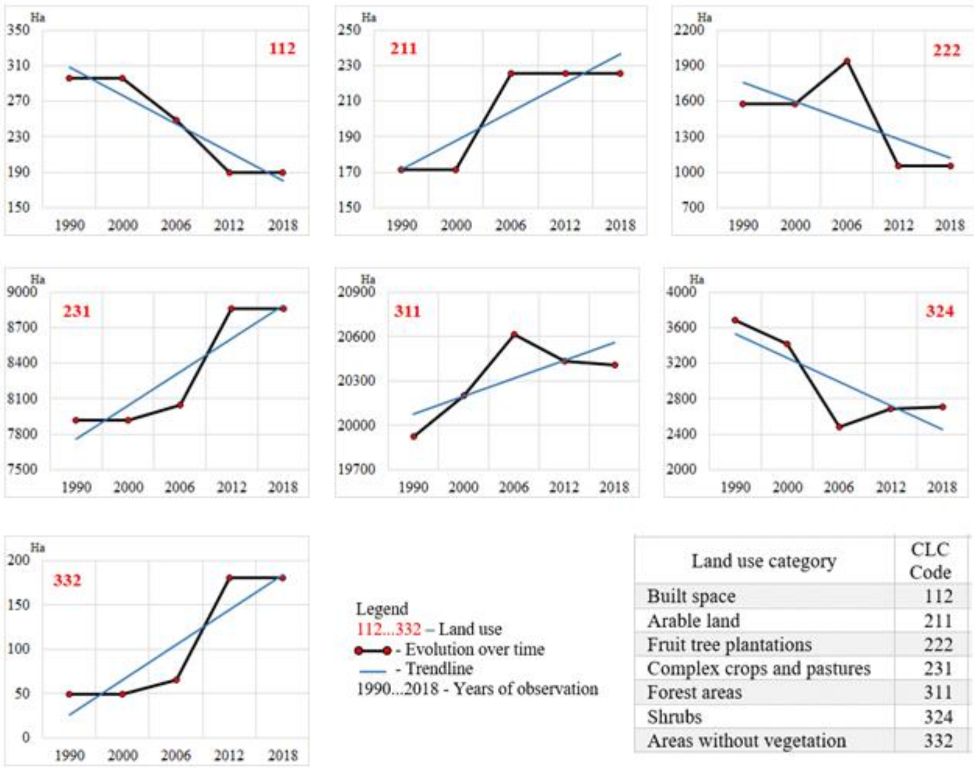


Figure 3 Land use in Teregova ATU, between 1990 and 2018 (processing after GEOSPATIAL, 2022; COPERNICUS LAND MONITORING SERVICE, 2022)

The grasslands are present in the low areas, respectively in the Timișului Corridor, but also in the lower area of the Semenic Mountains. At higher altitudes, in the Cernei Mountains, grasslands are interspersed with forest areas and in the Ţarcu Mountains, they appear on large areas above the forest boundary, in the form of alpine grasslands (Figure 3).

Regarding the land use, in the period 1990 - 2018 (Figure 3), differences were observed in terms of the territorial distribution of classes, but also quantitative changes (Figure 4).

Obvious surface reductions occurred in the case of built-up areas, especially after 2000 and in that of fruit plantations, especially after 2006 (Figure 4). One of the causes of these changes may be the depopulation of the area, through a negative natural balance and/or migration phenomena, a situation characteristic of other mountain areas as well (VERT, ANCUȚA, 2011; DAX ET AL, 2019; SIKORSKI ET AL, 2020). On the other hand, since 2006 there has been an increase in the areas intended for complex crops and meadows, against the backdrop of the stimulation of agriculture through specific programs and measures.

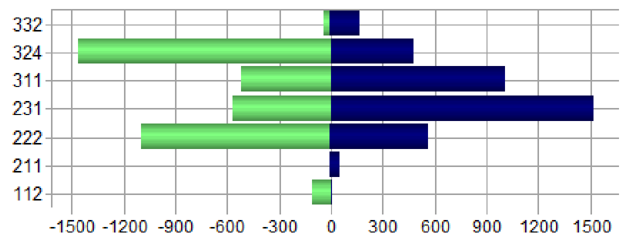


Land use category	CLC Code
Built space	112
Arable land	211
Fruit tree plantations	222
Complex crops and pastures	231
Forest areas	311
Shrubs	324
Areas without vegetation	332

Figure 4 Dynamics of land use classes in the period 1990 – 2018

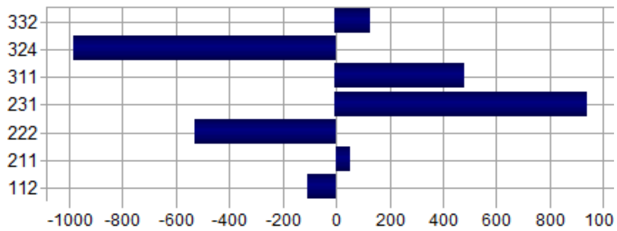
Analysis of changes in land use dynamics

For the detailed analysis of the changes produced in the considered time interval, the Land Change Modeler instrument from TerrSet was used. Thus, over the entire analyzed interval, the general "mobility" of the land use classes (Figure 5) occurred through surface increases and reductions, in all cases analyzed.



Legend: 112 - Built space; 211 - Arable land; 222 - Fruit tree plantations; 231 - Complex crops and pastures; 311 - Forest areas; 324 – Shrubs; 332 - Areas without vegetation
Figure 5 Gains and losses (ha) between 1990 and 2018

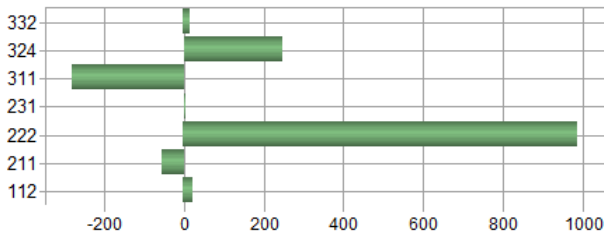
Between 1990 and 2018, in the case of grasslands, 574 ha were lost in some areas, but 1518 ha were gained in other areas, which means a net increase of the areas in this category by 944 ha (Figure 6).



Legend: 112 - Built space; 211 - Arable land; 222 - Fruit tree plantations; 231 - Complex crops and pastures; 311 - Forest areas; 324 – Shrubs; 332 - Areas without vegetation
Figure 6 Net Change (ha) between 1990 and 2018

The increase in the areas of grasslands and complex crops, by 944 ha, occurred by changing the way of using land from other categories (Figure 7), thus:

– 990 ha came from the clearing of fruit tree plantations, and 247 ha, from the clearing of lands with shrubs vegetation; approximately 40 ha were "recovered" from non-agricultural, non-productive land;



Legend: 112 - Built space; 211 - Arable land; 222 - Fruit tree plantations; 231 - Complex crops and pastures; 311 - Forest areas; 324 – Shrubs; 332 - Areas without vegetation
Figure 7 Contributions to Net Change in Complex crops and pastures (ha)

– 281 ha, originally used as grasslands, became forest areas, through their afforestation, a consequence of the phenomenon of abandonment of agricultural land in mountainous areas (BAUR ET AL, 2006, MARUȘCA ET AL, 2010; GUSTAVSSON ET AL, 2011; KIZEKOVÁ ET AL, 2018; DRĂGAN ET AL, 2020) and 55 ha were transformed into arable land.

The tendency to expand the agricultural area was boosted by the financial support programs that can benefit the communities of the mountain areas where agriculture has a subsistence character and is the main economic activity.

CONCLUSIONS

The Teregova administrative territory overlaps geologically and geomorphologically distinct relief units (Semenic Mountains, Cernei Mountains, Țarcu Mountains and Timișului Corridor), which is reflected in the arrangement of land use classes. In this context, forest areas predominate in mountainous areas, and at lower altitudes, agricultural land (grasslands, complex crops, arable land, etc.).

Between 1990 and 2018, there were changes in the way land is used, mainly determined by the socio-political situation of our country, but also by the possibilities of accessing financial support programs in the agricultural sector, considering the rural and mountainous character of the study area.

The spatio-temporal analysis of grassland surfaces shows an increase, especially through the abolition of fruit plantations and areas covered with shrubs. The recorded surface increase can also be explained by the programs to stimulate agricultural activities in rural areas.

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