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LANDSCAPE DYNAMICS IN THE SOMEȘ CORRIDOR. CASE STUDY: GURUSLĂU DEPRESSION (ROMANIA)

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ABSTRACT

Changes in land use patterns induced by different agricultural practices are reflected territorially through transformations at the level of elementary landscape units, with an impact on territorial identity and cohesion. The aim of this study is to highlight the dynamics of the territorial structures in the post-communist period (1990-2018), diachronically reflected in the transformations of the landscape of the Guruslău Depression, using the landscape metrics. The main direction of the scientific research was based on the analysis of land use changes and the identification of the spatial elements of structural-landscape distinction with impact on land degradation process. The evaluation of the landscape dynamics in the current context uses several effective metrics and tools, which increasingly require the identification of interdisciplinary methods of analysis, with a decisive impact on territorial development. Besides, the present approach is also motivated by the increasing environmental impact of climate change. The methodology used in the present paper is based both on the geoprocessing of vector data using GIS tools and correlated spatial analysis, and on the identification of landscape types using a new process of reclassifying land use categories, according to a set of landscape definition variables. The results of the research highlighted both the particularities of landscape transformations that occurred in the reference interval, as well as the favourable conditions for addressing biocultural diversity, by identifying traditional agricultural practices and the resilience of geographical landscapes given the adaptation to changing development strategies. Meanwhile, by detecting the landscape structures affected by change, in correlation with the impact induced on the biodiversity of the territory, the present study has a wide applicability in the most appropriate implementation of local development policies, as well as in identifying the forms of sustainable valorisation of the landscape in the study area.

Keywords: landscape, land use changes, Corine Land Cover, landscape metrics, landscape operators

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INTRODUCTION

The landscapes of a territory are composed of different elements associated in dynamic structures that impress a certain specificity (representativeness) on the geographical space differentiated according to the dominance of the relations of territorial synthesis. According to The European Landscape Convention (2000), landscape is defined as "a part of the land, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Romanian Government, 2002). It is well known that, today, the landscape is in a literal and metaphoric sense the horizon of our existence, and the lifestyle of the communities determines its structure and regional differentiation. In this sense, the landscape expresses the visual manifestation of territorial identity (Ilovan, 2020) and represents a depository of human culture (Antrop & Van Eetvelde, 2008).

The attempts to quantify the characteristics of complex spatial models associated with landscape heterogeneity and fragmentation have resulted in the application of various theories in other disciplines in the field of landscape ecology (Antrop, 2000). The result of this approach is the development of a wide variety of landscape metrics (Farina, 1998, 2006; Martinez-Falero & Gonzalez-Alonso, 1995), favoured by the development of spatial analysis techniques associated to the Geographic Information Systems (GIS) and satellite image processing (Antrop, 2000). Many of the landscape metrics are abstract and difficult to interpret, as they define immaterial, transcendent, or holistic aspects (Antrop, 2000).

The manifestation of the effects of climate change, the succession of land use patterns, along with the anthropic transformations induced by the exploitation of local resources and current geomorphological processes are the main vectors of the dynamics of landscape systems. Change is an essential feature of the landscape (Antrop & Van Eetvalde, 2008). Monitoring the dynamics of the landscape is important for understanding the interactions between social, environmental and geographical processes (Munroe & Müller, 2007), as well as for assessing how the condition of ecosystems and thus the life quality of the population is affected (Cabral et al., 2016; Affek, Zachwatowicz & Solon, 2020). The possibility of quantitative analysis of spatial models depends mostly on the availability of geographic data, being based mainly on map processing (Antrop, 2000), and on the development of various analyses based on geoinformation software (Trévisan et al., 2022). The bio-physical and socio-economic processes are dynamic from a spatial and temporal point of view, their changes influencing the aspect and functionality of the landscape (Bian & Walsh, 2002). The climate, biotic communities, population size and land use are constantly changing, drawing the attention of researchers and decision makers (Turner, 2010). In addition, land use changes represent a major concern of landscape analysis (Jongman, 1996), being approached from the perspective of assessing the evolution of socio-economic systems (Briassoulis, 2020).

In the recent years, studies addressing landscape dynamics from the perspective of human-environment interaction have become increasingly important, noting that the focus has shifted from identifying land use and associated changes (Loveland, Estes & Cepan, 1999; Lambin et al., 2001; Loveland et al., 2002; Li, Stoffelen & Vanclay, 2022) and the understanding of the driving forces of change (Antrop, 2005; Bürgi, Hersperger & Schneeberger, 2005), towards the modelling of territorial systems for making predictions regarding land use changes (Veldkamp & Lambin, 2001; Corgne et al., 2003; Hepinstall, Alberti & Marzluff, 2008) and exploring future landscape evolutions (Verburg et al., 2004; Kok & Verburg, 2007; Houet, Verburg & Loveland, 2010). Monitoring and modelling landscape dynamics depends on the scale of analysis and the aims of the spatial planning process (Houet, Verburg & Loveland, 2010; Godard et al., 2019). Thus, landscape dynamics analysis models should simulate both social, economic and ecological processes and how their interaction and dynamics influence the landscape (Baker, 1989; Gaucherel & Houet, 2009; Houet, Verburg & Loveland, 2010). The present study aims to identify the landscape structures associated with land use and their dynamics in the context of the analysis of a predominantly rural depression area, characterised by specific agricultural practices with a long tradition, which have imprinted a certain specificity in the territorial development profile. Landscape assessment is a necessary step in the field of territorial planning, especially in the management of agricultural systems (Antrop, 2000), and is of particular importance in terms of ecosystem resilience assessment (Degefu et al., 2021). The challenges facing rural areas are depopulation and the continuity of farming in highly urbanised areas (Antrop, 2000). The current landscape dynamics is a challenge in agriculture, aiming to assess the way the agricultural landscapes are managed by farmers (Benoit et al., 2012), because in this field the landscape is the system resulting from the interaction of farmers with natural and social resources through land management (Benoit et al., 2012; Egarter Vigl et al., 2016; Mojses, Petrovič & Bugár, 2022). The agricultural practices are based on and interact with natural resources, especially soil, water and biodiversity, either locally (van Ittersum & Rabbinge, 1997) or at a superior level (Vendkamp et al., 2001; Dalgaard, Hutchings & Porter, 2003).

In the case of the ecosystems with a significant anthropogenic impact, the human factor is the one that imprints the spatial and temporal dynamics of the landscape (Folke et al., 2007), and the ecological reconstruction process must take into account the spatial resilience (Bengtsson et al., 2003). Intensively managed areas are significantly different from the natural ones in that they do not have similar patterns of temporal evolution (Juska, Busch & Tanaka, 1997). Besides, the fragmentation of the landscape determines the reduction of areas with natural landscapes (Sharma et al., 2017), the ecological vulnerability of biotic communities and affects life quality at regional and local level (Ibáñez et al., 2014). The whole study area can be considered to belong to a multi-layered traditional landscape, dominated by centuries-old agricultural practices, which brings together a morphological, structural and functional complexity resulting from the long transformation of human-nature relations through the successive adaptation of settlement forms and agricultural, forestry and pastoral practices to the existing geographical conditions. In this sense, the present research was focused on the landscape dynamics in its complexity, precisely to allow the identification of evolutionary patterns in the organisation of space, based on discrete relationships of systemic collaboration and specific forms of territorial resilience.

STUDY AREA

The Guruslău Depression is individualised in the middle course of the Someș River, based on geological, structogenetic, geomorphological and landscape criteria. The depression subunit is located in Sălaj County and has an area of approximatively 14,500 ha (47°13'- 47°25' N; 23°12'- 23°21' E), comprising the largest parts of the communes of Benesat, Năpradea and Someș-Odorhei, as well as of one of the main urban centres in the county, the town of Jibou.

The study area is bounded by the adjacent main peaks (Runcului Hill – 375.4 m, Bârsei Hill – 411.6 m, Chicera Hill – 437.7 m, Rona Peak – 437.4 m, Iacobula Peak – 473.1 m, Țicla Peak – 454.7 m), which allowed its individualisation as a distinct unit within the Someș Corridor. The western boundary is represented by the Western Hills, through the Sălaj Hills subunit, and the eastern one, by Prisnel Peak (Figure 1). In the northern part, the Guruslău Depression is bordered by the Dealul Mare-Prisaca Massif and the Țicău Gorge (administrative boundary with

Maramureș County), while in the southern part the boundary is represented by Dumbrava Hill, which also marks the change of direction of the Someș River, from east-west to south-north.

The geographical position of the Guruslău Depression within the morpho-hydrographic corridor of Someș, which is the most important water resource in the region, favours demographic and energy-material flows, through the associated communication routes, materialised by the DN 1H national road and the 400-railway line that connect the two neighbouring counties (Sălaj and Maramureș). It is important the fact that the depression has an agricultural specificity, as the agricultural land accounts for over 50% of the total area, while in the city of Jibou there are significant industrial activities, mainly units of light and artisanal industry.

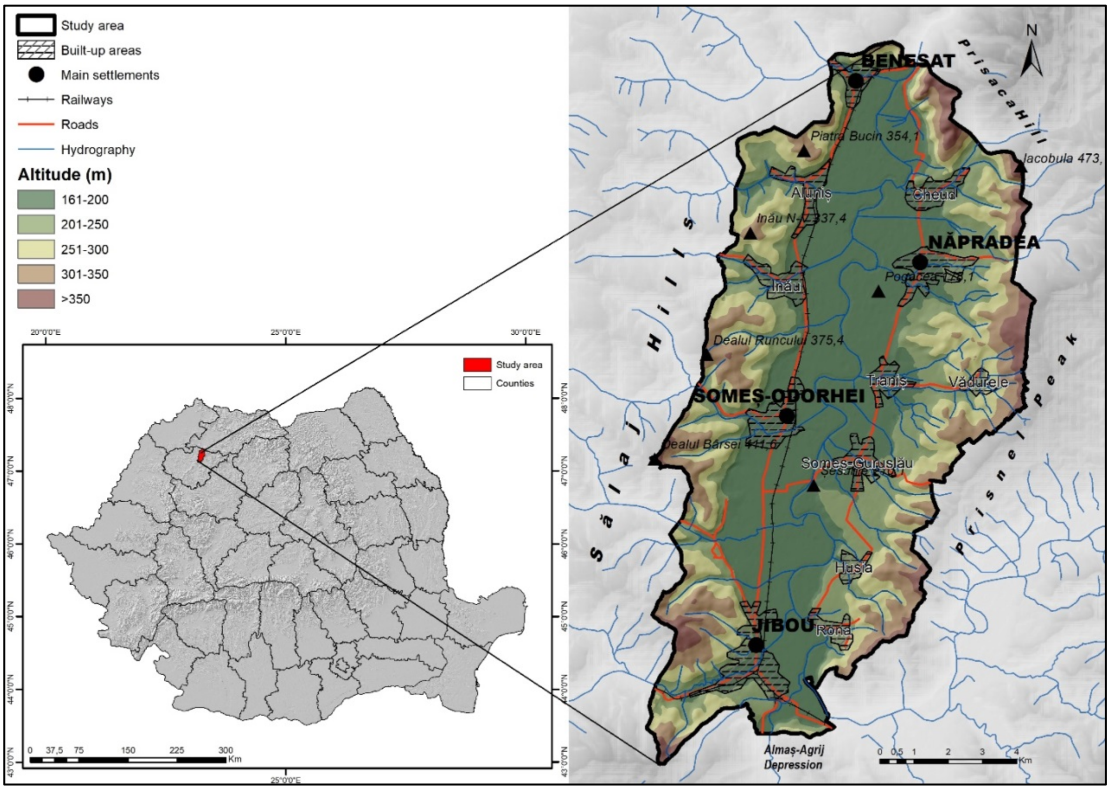

Figure 1. Framing in the territory of the Guruslău Depression

Source: The authors, based on vector and raster data from Geofabrik GmbH & OpenStreetMap Contributors (2018) and Earth Explorer USGS

METHODOLOGY

The analysis of the dynamics of the agricultural landscape must consider three key elements: agricultural practices, natural resources and landscape categories (Benoit et al., 2012), on the basis of which various interdisciplinary analyses can be carried out, in order to identify the interlinking relationships between landscape composition and its structure (Poggi et al., 2021; Trévisan et al., 2022). One of the indices taken into account in the present study is the patch density, as the process of landscape fragmentation is one of the most widespread processes at European level (Lausas & Nogue, 2012). The high degree of landscape fragmentation represents one of the elements with high potential for land vulnerability (Bănică & Muntele, 2015) and the analysis of the landscape mosaic structure is one of the most interesting scientific perspectives for understanding biocultural diversity at landscape level (Agnoletti, Tredici & Santoro, 2015). In addition, identifying the causal factors driving landscape dynamics is one of the major challenges in landscape ecology (Plieninger et al., 2016; Bürgi et al., 2017; Affek, Zachwatowicz & Solon, 2020).

The first work stage involved identifying landscape types, based on information provided by the CORINE Land Cover (CLC) database, which is a useful tool in carrying out various spatial analyses and land management plans (Feranec et al., 2016). In this paper, the CLC databases for the years 1990, 2000, 2006, 2012 and 2018 were used, through which correlative analyses between different land use classes were performed by processing vector databases for the analysed period. These were corroborated with digital processing of multispectral satellite images (Landsat 7 ETM+ and Landsat 8 OLI), downloaded from the Earth Explorer (EE) database of the United States Geological Survey (USGS) archives, with observations on orthophotoplans (0.5 m resolution), scanned maps and collecting field data.

For the comparative analysis, there were performed diachronic analyses on all land use categories, for the years 1990, 2000, 2006, 2012 and 2018, in order to map the dynamics and assess the transformations induced on the landscape system by land exploitation for a period of approximately 30 years. The 13 land use categories, identified according to the CORINE Land Cover legend, were reclassified into seven elementary landscape categories, based on a set of variables. Thus, it was first necessary to establish the landscape comparison operators, using a scale ranging from 1 to 5 (1- identical; 2- similar; 3- neutral; 4- different; 5- very different), respectively including them in four variables used in the analysis matrix: physiognomic similarity, process dynamics, structural homogeneity, and degree of landscape naturalness/artificiality. Each land use category was analysed through the filter of the four landscape definition variables, and finally, through the operation of uniting the polygons with the same value attributes, based on their relative similarity, it was possible to identify the territorial structures belonging to each of the seven landscape types: landscape of cultivated land, forest landscape, agropastoral landscape, residential landscape, industrial landscape, viticultural landscape, landscape of marshes and rivers.

The next work stage focused on a methodological framework for structural analysis by applying landscape metrics using GIS techniques with the extensions Patch Analyst 5.2 and Patch Grid 5.1, for ArcGIS 10, as well as by applying the function Spatial Statistics-Class/Landscape. It allowed quantitative assessment of changes at a specific moment reflected in land use, through the analysis of characteristic landscape indices (degree of fragmentation, diversity, spatial distribution of landscape units, etc.). To increase the spatial relevance of the landscape fragmentation index, the spatial interpolation method was used, based on the ArcGIS Kernel Density tool.

RESULTS AND DISCUSSION

Land use changes

The diachronic analysis of land use categories for the reference moments 1990, 2000, 2006, 2012 and 2018 is the first step towards identifying the evolutionary patterns that caused structural-functional changes on elementary landscape units, with particular implications for the biodiversity of the territory. It can be observed that the hierarchy of the percentage distribution of land use remained unchanged in all reference moments (Figure 2). Thus, the category of non-irrigated arable land, with an average area of 50.79 km^2, occupies the largest part of the Guruslău

Depression, having a percentage of 34.82%, followed by the broad-leaved forests (30.27%). The area is characterised by the predominance of cereal and vegetable crops, as well as of well-developed fruit-growing, especially in the north-eastern part. On the other hand, the smallest surfaces correspond to the categories of mixed forests (0.25 km^2) and vineyards (0.3 km^2).

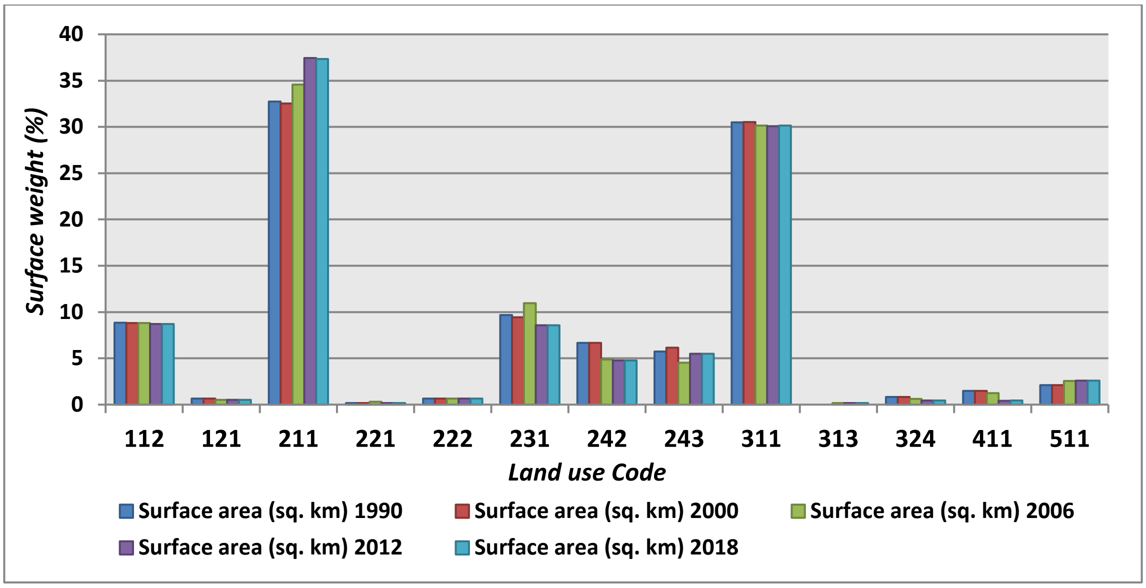

Figure 2: The weights calculated for land use areas in the Guruslău Depression

Source: The authors, based on extracted data from Copernicus Programme (2022)

The spatial distribution of land use categories over time shows a slightly pronounced evolution, mainly characterised by a decrease in the extent of most of the identified categories, against the background of the surface increase of the non-irrigated arable lands. Thus, this category is the only one whose spatial distribution has increased in the analysed period (Figure 3) and exceeded the value of 50.22 km^2, about 34.57% of the total area of the depression corridor, since 2006, extending mainly towards the periphery of the study area. This was the result of the inclusion in this category of areas belonging to pastures, areas of complex cultivation and agricultural land with significant areas of natural vegetation, as an effect of informing the owners of agricultural land about the possibility of obtaining subsidies for farmers since 2007, through the Agricultural Payments and Intervention Agency (APIA).

The category of land cultivated with fruit trees did not change during the analysed period, occupying a constant area of 0.97 km^2 at all reference moments, while the vineyards had the smallest change, with a decrease of only 0.01 km^2, followed by residential areas and industrial units, which reduced their areas by 0.15 km^2 and 0.23 km^2 respectively. The decrease in the area of land used for residential and industrial purposes has been evident since 2006, which we consider to be a benchmark year in terms of Romania's pre-accession to the European Union, together with other factors with a regional impact from the beginning of the post-accession period (increased migration, reduction in industrial activities, increased unemployment, etc.) and after this stage (ageing of the population, re-technologization of production processes, widening disparities between urban and rural areas, etc.).

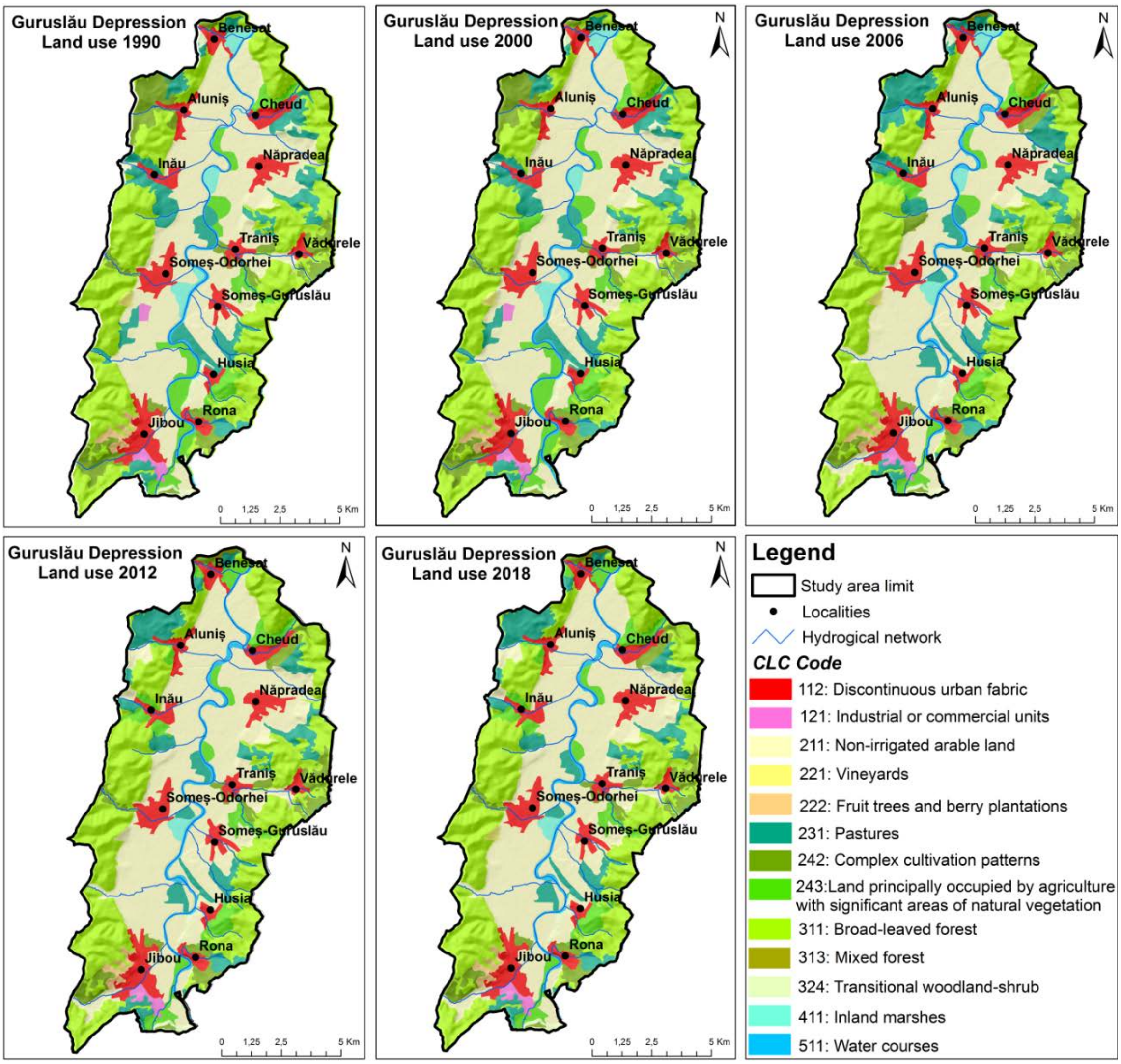

Figure 3: Land use in the Guruslău Depression (1990-2018)

Source: The authors, based on vector data from Geofabrik GmbH & OpenStreetMap Contributors (2018); Copernicus Programme (2022)

Landscape dynamics

The evolution of the landscape in the Guruslău Depression was performed by comparing maps of elementary landscape units from 1990 and 2018, in order to highlight the dynamics over an interval of about 30 years. By processing the information provided by CLC database and satellite images, seven landscape types were identified, namely: landscape of cultivated land, forest landscape, agropastoral landscape, residential landscape, industrial landscape, viticultural landscape and landscape of marshes and rivers. There can be observed changes in all landscape units, both in terms of spatial extent and distribution within the area, whether we refer to forested, seminatural, aquatic or urban and industrial areas (Figure 4).

The landscape of cultivated land has the largest area in both 1990 (65.49 km^2) and 2018 (69.28 km^2) and is the only one that has increased in the analysed period, by 2.61 % (3.79 km^2). It can be observed an extension of this category towards the periphery of the study area, in the northern and north-eastern extremity, as well as in the Someș River meadow zone, in areas that were previously occupied by the agropastoral landscape or that of marshes and rivers.

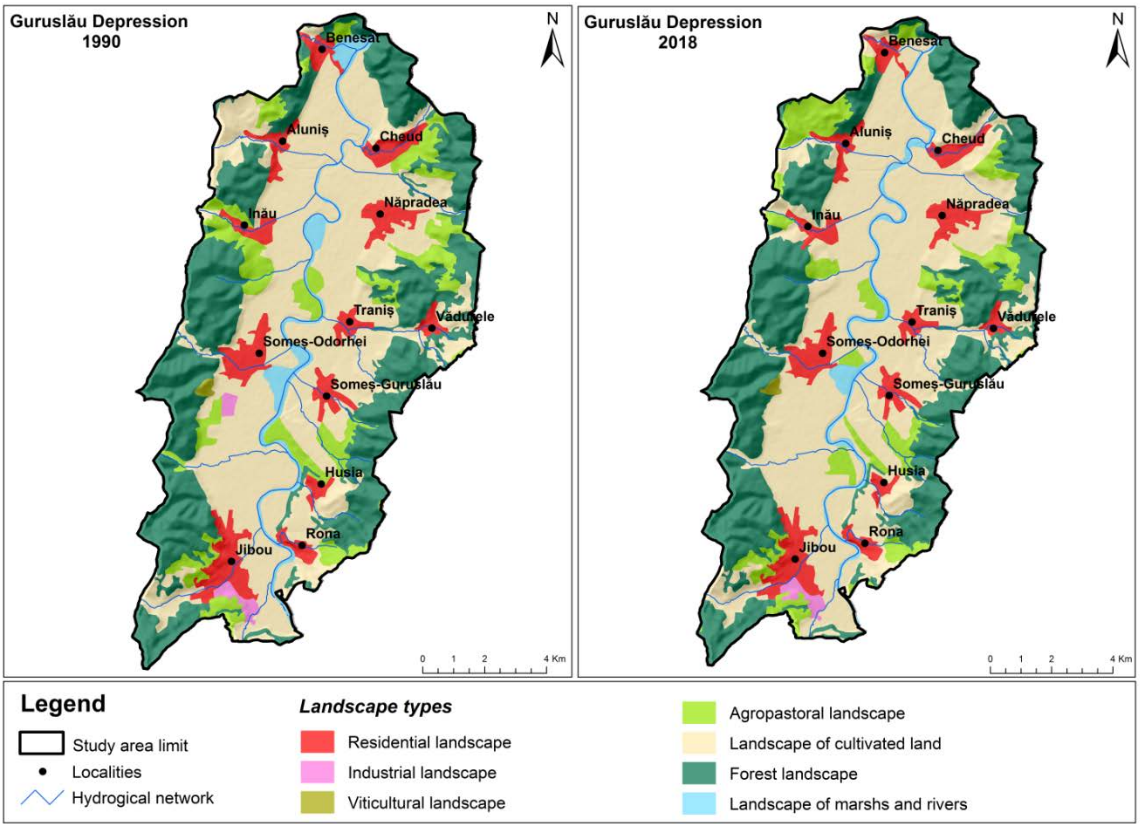

Figure 4: Landscape dynamics in the Guruslău Depression

Source: The authors, based on vector data from Geofabrik GmbH & OpenStreetMap Contributors (2018); Copernicus Programme (2022)

However, it is noticed a significant change in the distribution of the landscape of cultivated land, in the north-west of the Guruslău Depression, marked by the transformation of a significant part of it near the village of Aluniș into agropastoral landscape. On the other hand, all the other landscape units have recorded a reduction in their surfaces for the analysed period (Figure 5), depending on the sequence and impact of the changes induced at different stages of land use.

The agropastoral landscape is located close to the forest landscape, often making the transition between the latter and the one of cultivated land. Its area has decreased by 1.57 km^2, which is evident in the western part of the depression corridor, where its spatial extension has been considerably reduced near the village of Inău or in the sector between Jibou and Someș-Odorhei, where a significant part of the agropastoral landscape has completely disappeared. Changes in the extension of this landscape type are also highlighted in the proximity of the Someș River, especially in the southern half of the study area, as well as in the strip of coluvio-proluvial glacises near the villages of Inău, Cheud, Năpradea, and Aluniș.

The category of forest landscape is spatially identified at the peripheral area of the Guruslău Depression, having a decrease in surface of about 0.7 km^2. This is evident in the north and north-west of the study area, where the landscape of cultivated land has replaced a small part of the forest landscape. A similar decrease in area can be observed in the case of the landscape of marshes and rivers, of about 0.75 km^2, also in the favour of the expansion of agricultural land, which can be seen in some meander loops of the Someș River.

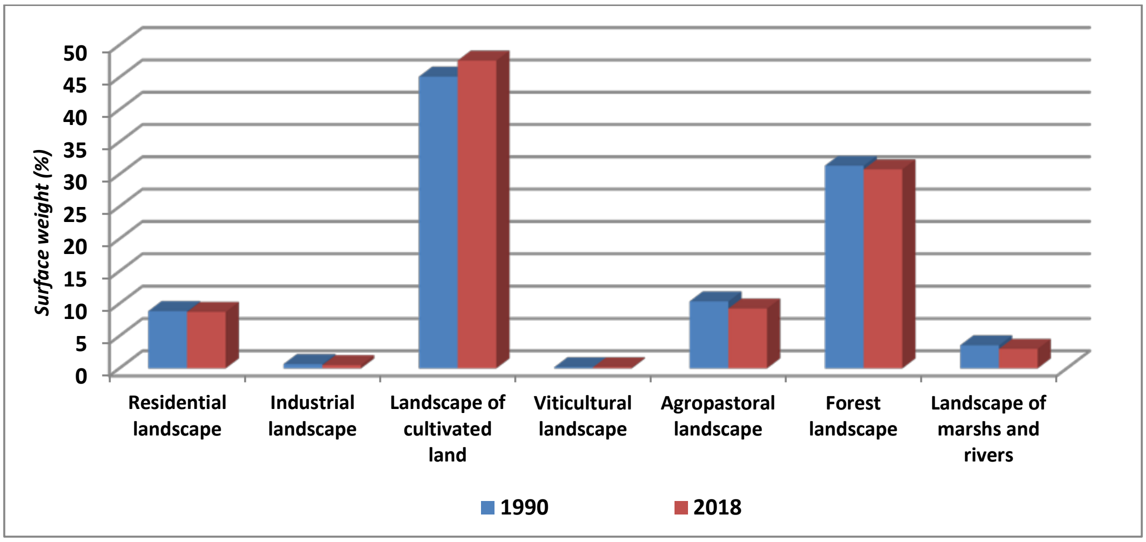

Figure 5: The weights calculated for landscape types in the Guruslău Depression (1990, 2018)

Source: The authors, based on extracted data from Copernicus Programme (2022)

The residential landscape is identified with the built-up areas of the administrative-territorial units in the study area, with 12 plots belonging to this category. It has changed insignificantly in the analysed period and has recorded a decrease in area of approximatively 0.15 km^2. This is due to the fact that most of the settlements belong to the rural area and are not located in the area of influence of a large urban centre of attraction, so that they are characterised by low dynamics, dominated by the traditional architectural structure of the housing space. However, it is obvious the extension of the residential landscape in the village of Inău (Someș-Odorhei commune), in the south-western part of this unit, while in the village of Cheud (Năpradea commune) a spatial reduction can be observed in its northern part, because of the depopulation and the abandonment of the construction sites located in the periphery.

Another landscape unit that has recorded a change in configuration and a spatial reduction in the analysed period (1990-2018), by 0.16% (0.23 km^2), is the one of industrial sites, area located in 2018 only in the outskirts of the town of Jibou, while in 1990 there was also a plot of this category in the Someș-Odorhei commune. The viticultural landscape has recorded the smallest changes, its surface being reduced by only 0.01% (0.01 km^2).

Landscape metrics

In order to identify ways to functionally optimise the territorial structures in the study area, we used spatial metrics to perform different quantitative assessments of land use classes, based on the landscape metrics (Pătru-Stupariu et al., 2011). The comparative analysis of the changes in spatial configuration, patch distribution, patch density and structural diversity of the geographic landscape for the years 1990 and 2018 was performed based on landscape metrics that were extracted using the extensions created for ArcGIS 10 software (Patch Analyst 5.2 and Patch Grid 5.1). The landscape metrics used were based on data from several indices: the Shannon Diversity Index (SDI), Mean Shape Index (MSI), Mean Perimeter Area Ratio (MPAR), Mean Patch Fractal

Dimension (MPFD), Area-Weighted Mean Patch Fractal Dimension (AWMPFD), Class Area (CA), Patch Density (PD), Mean Patch Edge (MPE), Mean Patch Size (MPS) and Edge Density (ED) (Table 1). The Shannon Diversity Index (SDI) is one of the most widely used metrics for quantifying the diversity of elementary landscape units. It is used to quantify the degree of organisation/ disorganisation of landscape systems, estimating the abundance of elemental landscapes (Boboc, Angheluţa & Munteanu, 2015).

Table 1: The dynamics of landscape metrics (1990-2018)

Landscape type / Landscape metrics	MSI		MPAR		MPFD		AWMPFD	
	1990	2018	1990	2018	1990	2018	1990	2018
Residential landscape	6.87	6.98	68.00	69.50	1.39	1.39	1.39	1.39
Industrial landscape	2.23	2.09	80.10	85.90	1.30	1.30	1.30	1.30
Landscape of cultivated land	9.07	9.54	39.70	40.60	1.39	1.39	1.39	1.39
Viticultural landscape	1.21	1.38	83.30	97.30	1.23	1.26	1.23	1.26
Agropastoral landscape	9.57	8.72	87.50	84.20	1.43	1.42	1.43	1.42
Forest landscape	9.13	8.74	48.00	46.30	1.39	1.39	1.39	1.39
Landscape of marshes and rivers	7.39	7.89	116.0	134.1	1.42	1.44	1.42	1.44
Mean	**6.49**	**6.48**	**74.66**	**79.70**	**1.36**	**1.37**	**1.39**	**1.39**

Landscape type / Landscape metrics	CA		MPS		ED		MPE	
	1990	2018	1990	2018	1990	2018	1990	2018
Residential landscape	1,284.1	1,269.6	1,284.1	1,269.6	6.01	6.06	87,299.9	88,207.5
Industrial landscape	97.19	74.48	97.19	74.48	0.54	0.44	7,783.7	6,399.2
Landscape of cultivated land	6,549.3	6,928.8	6,549.3	6,928.8	17.92	19.33	260,146.5	281,387.4
Viticultural landscape	26.42	25.21	26.42	25.21	0.15	0.17	2,199.8	2,453.4
Agropastoral landscape	1,502.16	13,45.87	1,502.1	1,345.8	9.06	7.79	131,454.6	113,362.8
Forest landscape	4,547.99	4,477.08	4,547.9	4,477.0	15.03	14.24	218,221.6	207,315.8
Landscape of marshes and rivers	510.04	435.34	510.04	435.34	4.07	4.01	59,146.9	58,367.0
Mean	**14,517.2**	**14,556.5**	**2,073.8**	**2,079.5**	**52.78**	**52.04**	**109,464.7**	**108,213.3**

MSI - Mean Shape Index; MPAR - Mean Perimeter Area Ratio; MPFD - Mean Patch Fractal Dimension; AWMPFD - Area-Weighted Mean Patch Fractal Dimension; CA - Class Area; MPS - Mean Patch Size; ED - Edge Density; MPE - Mean Patch Edge.

For the period 1990-2018, a slight decrease is noted (from 1.33 to 1.29), due to the numerical decrease of landscape units in the study area (in 2018 the share of landscape of cultivated land exceeded 47%, the forest landscape exceeded 30%, while the one of marshes and rivers was of only 3%). The Mean Shape Index (MSI) is a standardised indicator of landscape plot shape, calculated for each individual plot (Brown & Reed, 2012). It recorded an insignificant decrease in values, which was more pronounced for industrial, agropastoral and forest landscapes. Meanwhile, the other landscape units had a slight increase, against the background of a less pronounced territorial dynamics.

The analysis of the evolution of the Mean Perimeter Area Ration (MPAR), that expresses the complexity of the configuration of landscape units, highlights the most significant change of all the metrics considered, with the average value increasing from 74.66 (1990) to 79.7 (2018). The highest increases are recorded for the landscape of marshes and rivers (from 116 to 134.1) and for the viticultural landscape (from 83.3 to 97.3), while the lowest values of this indicator correspond to the agropastoral landscape and the forest landscape. The Mean Patch Fractal Dimension (MPFD) and the Area-Weighted Mean Patch Fractal Dimension (AWMPFD) have insignificant changes, both in terms of average values and at the level of individual landscape types, thus indicating the relative preservation of the degree of landscape fragmentation for the analysed period and the favourable conditions for the protection of the local biodiversity.

The degree of landscape fragmentation, without containing information on landscape composition or structure, was expressed by calculating the Patch Density (PD) (Figure 6) and estimating the density distribution of landscape units by Kernel Density interpolation (Figure 7).

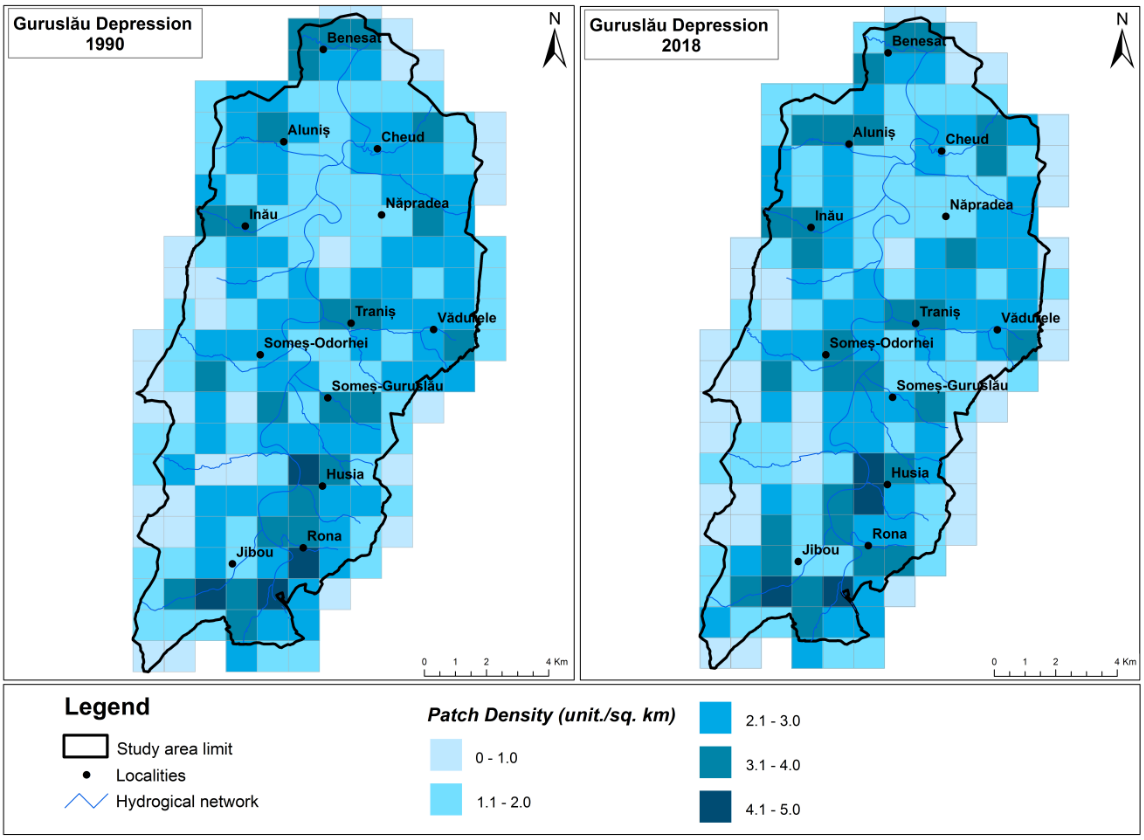

Figure 6: Density of elementary landscape units

The Class Area (CA) is the index that reflects landscape composition and allows estimations on the total area belonging to a class. In the study area, it is highlighted an expansion of the class area in the analysis interval (1990-2018) only for the landscape of cultivated land, by 2.49%. For the rest of the landscape types, there were recorded decreases of the area, ranging from 0.01% (viticultural landscape) to 1.1% (agropastoral landscape). It can be noticed that the changes induced by the forms of land use, due to the expansion of agricultural activities, are the most important factor of biodiversity change in the geosystem overlying the morphohydrographic corridor of the Guruslău Depression.

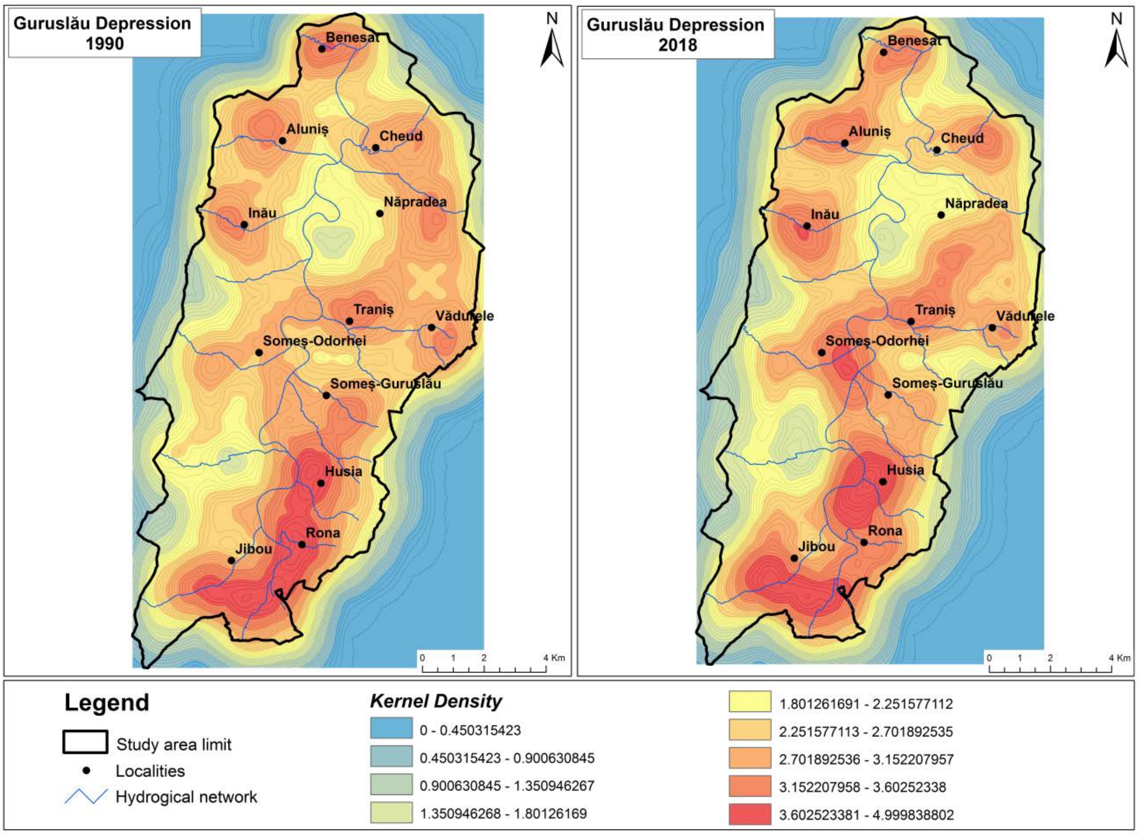

Figure 7: Distribution density of landscape units - Kernel Density

The comparative analysis highlights the predominance of territorial similarities of this index for the period considered, which expresses the preservation of a relative balance in terms of stability and evolution of ecosystems developed within this valley geomorphological subsystem.

The Mean Patch Size (MPS) has similar values for the years considered, with an insignificant increase, of only 0.01%, between 1990 and 2018. At the same time, the values of the Edge Density (ED) increased only for the landscape of cultivated land, from 17.92 m/ha in 1990 to 19.33 m/ha in 2018, which expresses both the expansion of cultivated areas (amid the reduction of the rest of the landscape categories) and increase in the degree of fragmentation of agricultural plots.

The values of the index expressing the Mean Patch Edge (MPE) have increased in the analysed interval only for the landscape of cultivated land (22.38%), residential landscape (1.76%) and the viticultural landscape (0.26%). The rest of the landscape types from the Guruslău Depression have percentage decreases of this index ranging from 15.33% (agropastoral landscape) to 0.09% (landscape of marshes and rivers). The analysis performed at this level allowed the evaluation of the landscape dynamics in the Guruslău Depression and highlighted the main interaction processes between the components of the study area. From this point of view, it is noticed a reduced landscape dynamics, which preserves evident territorial structures with a long evolution through traditional agricultural practices, pre-existing landscape parcelling and relative maintenance of the spatial extension limits of the landscape system. The specific landscape resilience forms of the Guruslău Depression express several adaptations of biotic communities, with an impact on local biodiversity. In this regard, it is worth mentioning the landscape fragmentation imposed by the depressional corridor morphology and the lack of connectivity between the western and eastern extremities of the territory, which requires the identification of solutions for the establishment of ecological corridors through the extension and transversal interconnection of forest ecosystems, grassland/pastures plots and aquatic areas.

However, this model can be extended and supplemented with other correlation indicators (demographic evolution, distribution of the settlements, natural potential, accessibility of the territory, relief suitability for spatial planning, etc.). The holistic view can further increase the complexity of the analysis by quantifying the rate of change and intensity patterns at the level of each land use category, along with the identification of evolutionary trajectories with an impact on sustainable development both at local and regional level.

CONCLUSIONS

The landscape transformations reflected in land use dynamics, as an interface between social and ecological processes, are one of the most important factors in changing the biological and cultural diversity of a territory. The analysis model performed for the Guruslău Depression enabled us to highlight the forms of manifestation of spatial conditioning relations, since the changes produced in land use are the result of economic, socio-cultural, political and biophysical processes reflected both qualitatively and quantitatively in the landscape structure, as a product of territorial synthesis and transformation. The present study has highlighted the specificity of the dynamics of landscape systems in the period 1990-2018, and the estimates performed by calculating several landscape metrics have revealed several particular values that have allowed the identification of the specific transformations of each land use class, reflected in the landscape of the study area (landscape composition and configuration, diversity of landscape units, landscape fragmentation and isolation, assessment of changes, etc.).

The methodological framework focused on the holistic approach to landscape structures, and, through the combined use of specific spatial analysis techniques and procedures, including landscape metrics, it was possible to map the dynamics and assess the transformations induced on the landscape system by land use over a period of approximatively 30 years. The reclassification procedure based on landscape comparison operators, applied according to a set of landscape definition variables at the level of land use categories, enabled the identification of landscape types in the study area.

The diachronic analysis of the land use categories for the reference moments indicates that the hierarchy of the percentage distribution of land use has remained unchanged. The spatial distribution of land use over time is characterised by a decrease in the extent of most of the categories identified, amid an increase in the area of non-irrigated arable land, due to the implementation of new agricultural policies as a result of Romania's accession to the European Union. The spatial metric indices highlighted several territorial similarities, but also disparities in terms of density, connectivity, and distribution of landscape units. It is noted that most of the localities belong to the rural category and are not in the area of influence of a large urban pole of attraction, so that they are characterised by low dynamics, dominated by the traditional architectural structure of the living space. Moreover, the analysis highlighted the phenomenon of landscape clustering based on the density of plots, an aspect that is reported in the proximity of the inhabited areas in the Guruslău Depression, where the long anthropic intervention has contributed both to the structural and functional diversification of interaction elements and changes in land use over time, as well as to changes in the ecological balance through fragmentation of habitats and, therefore, of elementary landscapes.

The results of the present study represent a useful documentary support for the implementation of local development policies and the establishment of regional development strategies, as well as for the identification of the endogenous potential of the territory and its integration into projects eligible for funding from public sources.

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