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THE IMPACT OF LAND USE CHANGES ON NATURAL PROTECTED AREAS IN THE OLTEȚ PIEDMONT (ROMANIA)

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Abstract

The identification and assessment of the pressures and threats to which protected areas are subjected is crucial in order to plan, implement and assess conservation actions. Our study aimed to assess the spatio-temporal dynamics of land use/land cover changes that occurred in the Olteț Piedmont between 2012 and 2018 and identify the main threats that anthropogenic activities pose to natural protected areas. The major changes in land use that took place between 2012 and 2018 had a great impact on the landscape. The disappearance of large surfaces of vineyards (–8150 ha), orchards (–2400 ha), watercourses (–700 ha), beaches, dunes and sand plains (–140 ha) and inland marshes (–40 ha) are the most significant. These terrains were occupied by complex crops (+4350 ha), deciduous forests (+2900 ha) and transitional woodland shrub (+750 ha). Also, the built-up areas, especially near cities like Craiova, Filiași, Balș and Drăgășani, had an increase in surface. The results revealed that the expansion of arable land and urban areas have a great impact in the conservation of biodiversity in natural protected areas from the Olteț Piedmont.

Key words*: land use, land cover changes, natural protected areas*, *Olteț Piedmont, Romania*

INTRODUCTION

Land is a three-dimensional, dynamic, and complex system, developed through the interaction of lithology, structure, drainage, climate, vegetation, and geomorphological processes operating over time (Laha, 2023). As a fundamental natural resource, it underpins diverse economic, social, and ecological functions (Phuong & Thien, 2023).

Within this context, land use and land cover (LULC) emerge as interrelated dimensions that describe both the ways land is utilized and the distribution of vegetation and surface features. Transformations in LULC not only reshape landscapes but also intensify global challenges such as climate change, biodiversity loss, and broader environmental crises (Bairwa et al., 2025).

LULC effects and dynamics vary from one region to another according to the type of vegetation cover and activities (Mesmin et al., 2025). Land use and land cover changes (LULCCs), driven by deforestation, forest degradation, and the expansion of human activities - such as agriculture, infrastructure development, and fuelwood extraction - have historically led to widespread land cover loss on both local and global scales (Nkinda et al., 2025). These changes have an impact on a wide range of environmental and landscape attributes, including the quality of water, land and air resources, ecosystem processes and function, and ecosystem quality (Yogesha et al., 2025; Shastri et al., 2020).

Changes in land cover and land use caused by human activities have modified the plant cover (Valea, 2024), forest ecosystems (Prăvălie et al., 2022), deforestation can lead to excessive soil erosion (Nigussie et al., 2025) and even landslide occurrence (Jurchescu et al., 2023).

Protected areas were "invented" and then established all over the world in order to protect the most outstanding values of biological and geological diversity, as well as exceptional cultural values.

The management of protected areas must ensure measures to prevent threats that may

destroy them in the future and if they can reduce the effects of the many pressures that exist today.

The development of urbanization around the world may have a negative impact on some existing plant and animal species (Ives et al., 2016). Nature plays an important role for human health, therefore measures must be taken to preserve biodiversity (Kowarik et al., 2020).

Biodiversity must be approached in relation to the characteristics of the urban and rural environment, plants, animals, the interaction and the pressure people put on nature for their own existence (Elmqvist et al., 2013; Opoku, 2019; Güneralp & Seto, 2013; Aronson et al., 2014).

The role of protected areas in conserving biodiversity and landscape is very important due to global environmental changes and climate change. For an adequate management there is a need to create corridors to link them in order to reduce human impact (Geacu et al., 2012).

In the context of sustainable development of cities and rural communities, it is necessary to find solutions to stop the loss of plant and animal species and maintain restore biodiversity.

Land use change is one of the issues which intensifies environmental problems because of the growing demand for natural capital and the increasingly anthropogenic interference; it threatens ecosystems on which human livelihoods rely upon. So, understanding the magnitude of land use change, drivers, and implications is very crucial in a successful management of land resource (Mekonnen, 2025).

MATERIALS AND METHODS

Study area

The Olteț Piedmont, located in the eastern subunit of the Getic Plateau, represents a geomorphological unit strongly influenced by both morphodynamic processes and anthropogenic activities dating back to the 17th-19th centuries. The region covers approximately 3,771 km² and has a predominant north-south orientation (Figure 1). Intensified human impact, particularly from the late 19th to the early 20th century, disrupted the natural balance through widespread deforestation to create land for cereal crops, orchards, vineyards, pastures, hayfields, as well as through the expansion of rural and urban settlements.

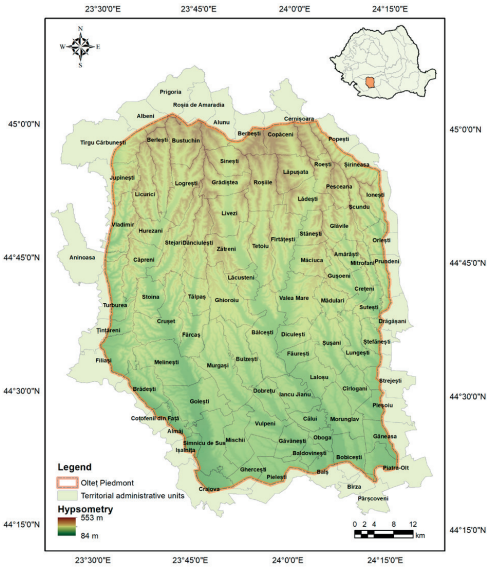

Figure 1. Study area - Olteț Piedmont (Romania)

During the past century, the Romanian agricultural lands underwent deep transformations primarily under the impact of political and socio-economic factors and less, of the biophysical and climatic ones (Bălteanu & Popovici, 2010; Popovici et al., 2013).

Given the major and ongoing spatial, structural and functional transformations of the post-communist period, a substantial body of literature has focused on the social and economic consequences of the Land Reform of 1991 (Urșanu et al., 2024; Dogaru et al., 2024). This reform (Law no. 18/1991) shifted the ownership of land from state to private individuals, small-scale farms appearing and fragmenting the agricultural land, which in time became vulnerable to anthropogenic pressure and climate changes (Prăvălie et al., 2021).

For monitoring land dynamics, the CORINE Land Cover (CLC) project, initiated in 1985, provides a harmonized inventory of land cover across Europe, structured into 44 classes. Building on this, the Copernicus Land Monitoring Service (CLMS), launched in 2012

by the European Environment Agency (EEA) and the European Commission's DG Joint Research Centre, supplies geospatial information on land cover and land-use changes, vegetation state, the water cycle, and Earth surface energy variables for a wide range of terrestrial applications.

In this study, we employed land use/land cover (LULC) databases provided by the EEA for the years 2012 and 2018. This period was selected as it captures the most significant changes in LULC, largely driven by anthropogenic activities. Notably, rising living standards spurred the rapid urbanization of rural areas near cities, where populations increasingly purchased land for residential purposes, particularly secondary homes used on weekends as retreats from urban environments.

Additionally, shapefiles of Romania's natural protected areas were obtained from the Ministry of Environment, Waters and Forests, along with management plans and other relevant data for the five protected areas located within the Olteț Piedmont. These sites were declared under the provisions of OUG 57/2007 and Law 5/2000. Using ArcGIS 10.7, the data for the study area were extracted (via the *Clip* feature), enabling a detailed analysis of how LULC changes affect these protected natural areas.

RESULTS AND DISCUSSIONS

The classified LULC categories comprised built-up areas, farmland, bare land, grassland, forests, wetlands, shrubland, and water bodies. Using ArcGIS 10.7, we extracted and reclassified 21 land use/land cover categories identified within the Olteț Piedmont. The results were represented through cartographic outputs (Figures 2 and 3) for the two reference years of the study, 2012 and 2018.

The period between 2012 and 2018 is marked by major changes in several land use categories (Table 1). Notably, there was a significant reduction in the areas occupied by vineyards (−8,150 ha), orchards (−2,400 ha), watercourses (−700 ha), beaches, dunes, and sand plains (−140 ha), as well as inland marshes (−40 ha). The decline observed in the latter three categories can largely be attributed to flood protection works implemented along most rivers crossing the piedmont.

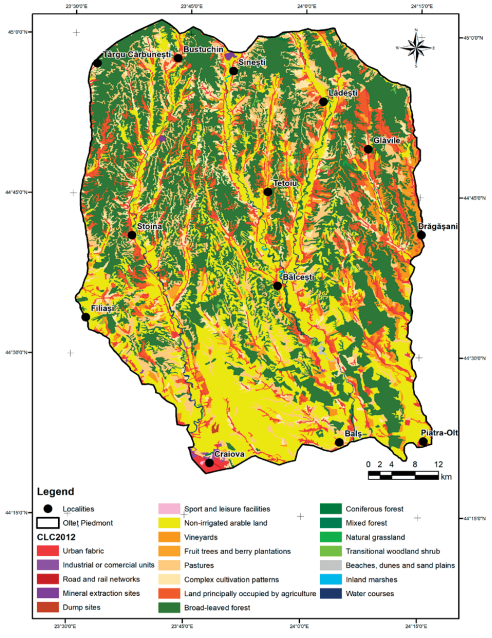

Figure 2. Olteț Piedmont - Corine Land Cover, 2012

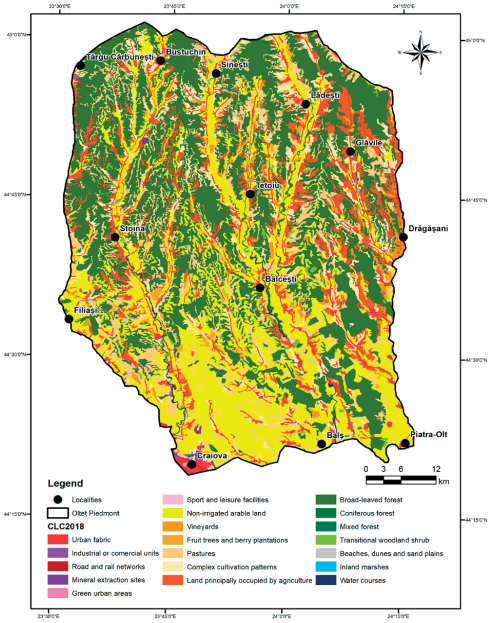

Figure 3. Olteț Piedmont - Corine Land Cover, 2018

The terrains occupied by vineyards and orchards were transformed mainly into areas with complex crops (+4350 ha), deciduous forests (+2900 ha) and transitional woodland shrub (+750 ha). Also, the built-up surface

increased by 610 ha, mainly by the extension of urban areas around major cities like Craiova, Filiași, Balș and Drăgășani.

The constant depopulation of the rural areas within the Olteț Piedmont and the expansion of the periurban areas around major cities have influenced the major changes in land use/land cover between 2006 and 2018. These changes affect not only its population but also the environment.

The influence of human activities has been manifested in all geographical regions of Romania. These have significantly influenced the rate, intensity and pattern of land use/cover changes. Important agricultural areas in the Romanian Plain have become fragmented and gradually abandoned but also subjected to (sub)urbanization processes (Urșanu (Popovici) et al., 2024).

Land use has been seriously influenced by urbanization and by the conversion from one category to another. This has led to the degradation of vegetal associations, the almost destruction of the wild flora and fauna in areas suitable to cultivation (Popovici et al., 2010).

Tabel 1. Land use in the Olteț Piedmont between 2012 and 2018

Land use	Area 2012 (ha)	Area 2018 (ha)
Urban fabric	18105.71	18715.64
Industrial or commercial units	578.45	643.63
Road and rail networks	130.84	130.62
Mineral extraction sites	277.95	237.79
Dump sites	151.62	-
Green urban areas	-	4.40
Sport and leisure facilities	37.44	37.44
Non-irrigated arable land	106522.92	107085.46
Vineyards	12551.88	4370.34
Fruit trees and berry plantations	7894.80	5492.06
Pastures	36379.22	36750.09
Complex cultivation patterns	19823.28	24170.46
Land principally occupied by agriculture	31274.33	33208.10
Broad-leaved forest	139633.92	142516.62
Coniferous forest	142.25	142.25
Mixed forest	53.88	53.88
Natural grassland	96.08	-
Transitional woodland shrub	1257.81	2070.48
Beaches, dunes and sand plains	213.26	77.26
Inland marshes	126.49	85.48
Water courses	1903.59	1363.71

The southern part of Romania was continuously exposed to strong human pressure since early times through extensive/intensive agricultural use, industrialization, urbanization/suburbanization processes. Therefore, the primeval vegetation has been massively transformed, and forests have been significantly fragmented and reduced to even smaller surface (Geacu et al., 2018).

In the study area there are 5 natural protected areas - 3 of national interest and 2 Natura2000 sites (Figure 4): 2.451 Locul fosilifer Valea Desului (1 ha), 2.796 Pădurea Tisa Mare (50 ha), 2.797 Pădurea Silea (25 ha), ROSCI0168 Pădurea Sarului (6768 ha) and ROSCI0296 Dealurile Drăgășaniului (7265 ha).

The International Union for Conservation of Nature (IUCN) defines a protected area as "a clearly delimited geographical space, recognized, designated and managed on the basis of legal acts or by other effective means, with the aim of achieving the long-term conservation of nature as well as of environmental services and associated cultural values".

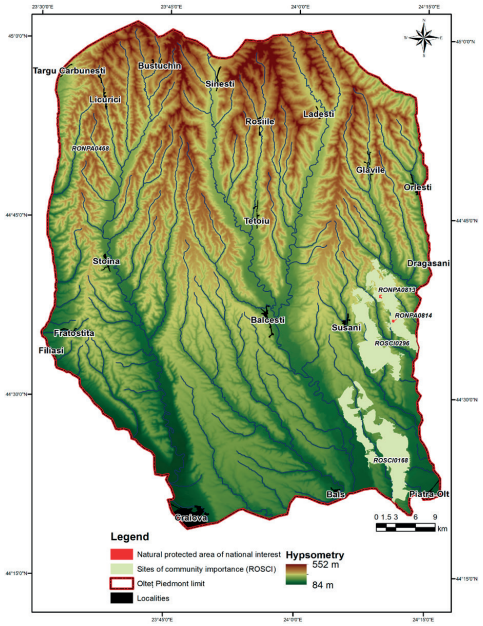

Figure 4. Olteț Piedmont - natural protected areas

Protected areas must guarantee and allow the following:
- conservation of biodiversity by maintaining within the perimeter of protected areas some species and ecosystems in their natural or very close to natural state;
- scientific substantiation of management methods and procedures that allow for the sustainable use of natural resources;
- scientific substantiation of the process of reconstruction and rehabilitation of ecological systems;
- maintenance of ecological services by conserving ecosystems;
- protection of cultural values and landscapes.

2.451 Locul fosilifer Valea Deșului fossil site is a protected area of national interest corresponding to IUCN category IV (paleontological nature reserve), protecting remains of Levantine fossil fauna.

2.796 Pădurea Tisa Mare is a protected natural area corresponding to IUCN category IV (mixed nature reserve) and represents a protection zone for trees of the species sessile oak (*Quercus petraea*) and hornbeam (*Carpinus betulus*) and shrubs of the species tulichine (*Daphne mezereum*) or thorn (of the species *Ruscus aculeatus*).

2.797 Silea Forest is a protected natural area that corresponds to IUCN category IV (mixed nature reserve) and represents the forested area on the two banks of the Silea stream that preserves natural habitats with tree species of sessile oak (*Quercus petraea*) and hornbeam (*Carpinus betulus*), as well as a rare shrub species, known as thorn (*Ruscus aculeatus*).

ROSCI0296 Dealurile Drăgășaniului includes 3 types of protected habitats: 9130, 91M0 and 91Y0.

ROSCI0168 Pădurea Sarului includes only 1 type of protected habitat, 91M0.

These protect a large number of species of conservation importance: over 30 species of mammals, over 90 species of birds, 1 species of plant and 8 species of amphibians and reptiles.

The important changes in land use and the constant increase in urbanization can have a major impact on these natural protected areas by: the use of pesticides and chemical fertilizers in agriculture, in the vicinity of these areas, the existence and spread of invasive plants and water pollution with plastic, glass, household or construction waste. Also, illegal deforestation and poaching represent a major threat to the integrity of natural protected areas.

We have managed to identify the main anthropogenic activities that may have a negative impact:
- harvesting of wild animals (legal/poaching);
- harvesting of mushrooms and berries;
- harvesting of live snails;
- logging activities (legal/illegal) in the funds managed by the Forest Districts;
- development of water and wastewater infrastructure;
- reconstruction works of communal roads, which cross protected natural areas.

These pressures and threats to which protected natural areas are subject must be considered when we study how land use/land cover changes affect the environment because they are an integrant part of a sustainable development for the population in this area.

CONCLUSIONS

The environment constitutes an essential prerequisite for human existence, so its protection and conservation is very important.

The predominance of agricultural activities in the southern part of the Olteț Piedmont, mainly in the rural localities, had a major impact in the land use changes that occurred in the last 20 years.

The major changes in land use, especially after 2012, have put a great pressure on the environment, modifying the landscape and making it more vulnerable to the effects of human activities and even climate change.

To preserve the protected habitats and species in these natural protected areas, administrators and decision-makers should consider the following measures:

- limit the use of pesticides and fertilizers in the vicinity of these sites and using insecticides only in the affected areas, not preventively;
- use of biological control as much as possible and preserve natural regulation mechanisms;
- limit access into the forest only on arranged trails and carrying out picnics and open fires only in designated areas;
- stop illegal deforestation;
- preserve, especially near wetlands, fallen trees or stumps, to boost the biological activity of insects;
- carry out actions to sanitize temporary ponds and waters within the perimeter of these sites;
- preserve open forest areas with shrub and grass vegetation, etc.
- prevent and stop activities with potential negative effects on the natural and cultural values in the protected areas;
- informing and raising awareness among stakeholders and the general public about the importance of biodiversity conservation, by promoting sustainable development models and involving local communities in the management of protected areas.

Future studies should focus on the effectiveness of protected natural areas management and minimizing anthropogenic impact on their territory in order to achieve a better conservation and protection.

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