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STUDY ON THE MANAGEMENT OF LAND USE CHANGE BY LAND USE CATEGORIES IN THE SOUTH-WEST OLTENIA DEVELOPMENT REGION, DURING THE PERIOD 1990-2023

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Abstract

This paper analyzes the dynamics of land use and land cover in the South-West Oltenia region of Romania over the period 1990-2023, using official statistical data concerning agricultural and non-agricultural areas, as well as their respective land use categories. While the total land area has remained constant throughout the analyzed interval, the distribution among land use categories has undergone significant changes. At the regional level, agricultural lands-particularly arable land and pastures-have shown relatively stable trends, whereas areas cultivated with vineyards and orchards have experienced a marked decline. Forested areas have slightly increased, reflecting efforts toward reforestation and environmental conservation. Built-up areas, including construction and infrastructure, have expanded noticeably, highlighting socio-economic development and the growing demand for built spaces. Conversely, the surface area of unproductive lands has increased substantially, underscoring the urgent need for land rehabilitation measures and interventions to combat land degradation. The study emphasizes the challenges posed by land degradation and the necessity of implementing sustainable land management policies that balance agricultural productivity, environmental protection, and urban expansion. The findings provide a robust foundation for decision-makers and regional planners in promoting sustainable territorial development in the South-West Oltenia region.

Key words*: land use planning, sustainable land management, territorial planning, South-West Oltenia, LULC.*

INTRODUCTION

Objectives such as poverty eradication, food security, gender equality, and environmental protection represent essential strategic directions for any state (Desa, 2016; Păunescu et al., 2022). Achieving these objectives requires the implementation of land administration systems aimed at identifying, assessing, and regulating land use, thereby facilitating the development of coherent land policies and the implementation of effective land resource management strategies. Central components of such systems include land registration and cadastral records (Williamson et al., 2010; Croitoru et al., 2023).

In recent decades, the study of land use and land cover (LULC) dynamics has gained strategic importance in the fields of environmental sciences, geography, spatial planning, and sustainable development policy. LULC changes reflect the complex interplay between natural processes and anthropogenic pressures, with significant impacts on biodiversity, soil quality, hydrological regimes, and local and regional climate (Călina et al., 2025; Sajan et al., 2022). Moreover, LULC is regarded as a key factor in ecosystem services assessment models, environmental risk analysis, and in the elaboration of urban and rural planning scenarios (Quintas-Soriano et al., 2016).

Romania, as a member state of the European Union, has undergone major territorial and economic transformations over the past decades, driven by the transition from a centralized to a market economy, agrarian reforms, and the European integration process (Călina et al., 2025; Călina et al., 2023; Păunescu et al., 2022). These transformations have directly influenced land use patterns, manifested through agricultural land abandonment, uncontrolled urban sprawl, natural or planned reforestation, as well as functional land use conversions resulting from European agricultural policies-such as the Common Agricultural Policy (CAP) (Călina et al., 2025; David et al., 2016, Petrişor et al., 2020) and local socio-economic pressures.

The South-West Oltenia region, located in the south-western part of the country, comprises the

counties of Dolj, Gorj, Mehedinți, Olt, and Vâlcea (Figure 1) and is characterized by a notable geographical and functional diversity-from lowland areas suitable for intensive agriculture to mountainous and sub-mountainous zones with extensive forests and valuable natural habitats (Miluț et al., 2020). This region has been affected by multiple, and often contradictory, territorial processes: on the one hand, the intensification of agriculture in lowland areas; on the other, the socio-economic decline of certain rural communities, accompanied by land abandonment, spontaneous reforestation, or degradation of agricultural land (Bălteanu et al., 2013; Mocanu et al., 2018). In addition, some county capitals (Craiova, Târgu Jiu, Râmnicu Vâlcea) and their peri-urban areas have experienced steady expansion, significantly influencing land use patterns.

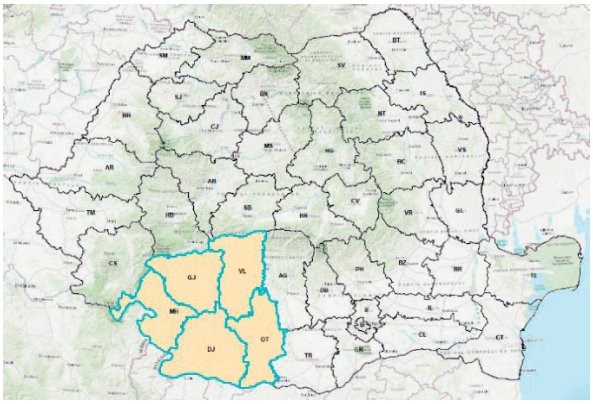


Figure 1. Study Area: South-West Oltenia

In this context, the analysis of LULC in the South-West Oltenia region is not merely a subject of applied research, but also a necessity for the formulation of public policies adapted to territorial realities (Călina et al., 2025). Although standardized databases exist at the European level (such as CORINE Land Cover and Urban Atlas), they offer relatively low spatial and temporal resolution and often fail to capture the rapid dynamics of local changes in detail. The use of multispectral satellite imagery, combined with modern techniques of automated classification and GIS-based processing, provides an opportunity to analyze long-term functional changes in land use (Kucsicsa et al., 2019; Popovici et al., 2013). However, the use of statistical data provided by national institutions allows for a more detailed and annually updated analysis of these changes.

The main objective of this study is to investigate LULC changes in the South-West Oltenia region between 1990 and 2023, using statistical data, in order to understand the extent and direction of territorial transformations. The study pursues the following specific objectives:

- To identify and classify the main types of land use and land cover at different temporal intervals;
- To determine the quantitative and qualitative changes within these classes;
- To correlate these changes with local and regional socio-economic and political factors.

This analysis aims not only to describe the current state of land use, but also to highlight change patterns that may influence spatial planning, rural development strategies, and environmental conservation policies in the South-West Oltenia region. At the same time, the study may contribute to the validation and enrichment of European land cover databases, providing a more accurate and detailed representation of local realities.

MATERIALS AND METHODS

For the purpose of this study on land use and land cover dynamics in the South-West Oltenia region, official statistical data regarding land areas for the period 1990-2023 were utilized. The data were organized according to functional land categories and by the component counties of the region (Dolj, Gorj, Mehedinți, Olt, and Vâlcea). The main sources of data were reports and databases provided by national institutions responsible for monitoring land resources (https://insse.ro/cms/en, last accessed on June 22, 2025; https://insse.ro/cms/en, last accessed on June 22, 2025), which offer detailed records of land areas categorized by various forms of use (arable land, pastures, hayfields, vineyards and viticultural nurseries, orchards and fruit tree nurseries, forests, water bodies, buildings, transportation infrastructure, degraded and unproductive lands, and other areas) (Miluț et al., 2018; Miluț et al., 2020).

Data Processing and Database Organization

The data were collected, centralized, organized, and processed within a unified database using dedicated software (Microsoft Excel). For each

functional land category and for each individual county, both absolute values and relative shares (percentages of total land area) were recorded or calculated. Data coherence verification techniques were applied, and any inconsistencies were corrected by cross-referencing the available annual datasets.

Temporal Analysis and Trends

The temporal analysis focused on the evolution of agricultural and non-agricultural land areas over the period 1990-2023, highlighting significant increases or decreases for each land use category. To identify trends and critical periods, descriptive statistical methods were employed, including moving average analysis and simple linear regression applied to the time series. These methods enabled the quantification of change rates and the development of preliminary projections.

GIS-Based Spatial Analysis

To gain a spatial understanding of land use changes, the statistical data were integrated into a Geographic Information System (GIS) using ArcMap software. Although the original data were aggregated at the county level, their integration into the GIS environment enabled the generation of thematic maps that illustrated territorial differences and the spatial dynamics of key land categories (agricultural vs. non-agricultural lands, forested areas, degraded lands, etc.). Comparative map series were created for specific time intervals (Călina et al., 2025), facilitating the observation of the spatial and temporal expansion or reduction of particular land use types.

RESULTS

In the South-West Oltenia region, which includes the counties of Dolj, Olt, Vâlcea, Mehedinți, and Gorj, the evolution of land use between 1990 and 2023 reveals an interesting dynamic in the relationship between agricultural activities, urban development, and natural resource conservation.

The analysis was conducted based on statistical data collected from the National Institute of Statistics (https://insse.ro/cms/en, last accessed on June 22, 2025) and the National Agency for the Environment and Protected Areas (http://www.anpm.ro/, last accessed on June 22, 2025), as presented in Table 1 (National Institute of Statistics, 2025).

Table 1. Collected and analyzed data (areas expressed in hectares, disaggregated by county, year, and land use category)

County	Year	Agr	A	P	M	V	O	NAgr	F	W	C	R	U	Oth
DJ	1990	590073	484651	74073	2942	16037	12370	151328	81547	25193				44588
	1995	588572	485597	71445	2763	18965	9802	152829	81482	22569				48778
	2000	588944	489004	69390	2993	18810	8747	152457	81580	22110	29277	13760	5730	
	2005	585699	488677	68435	2952	17538	8097	155702	85041	20757	30480	13694	5730	
	2010	585469	488820	68506	2952	17334	7857	155932	85087	20773	30598	13723	5751	
	2015	585135	488560	69356	2976	16875	7368	156266	85308	20886	30510	13536	6026	
	2020	585135	488560	69356	2976	16875	7368	156266	85308	20886	30510	13536	6026	
	2023	585135	488560	69356	2976	16875	7368	156266	85308	20886	30510	13536	6026	
GJ	1990	250776	102803	85750	40577	8433	13213	309398	273916	4681				30801
	1995	250204	103234	84787	40518	8399	13266	309970	273868	4681				31421
	2000	250271	103410	85124	40559	8236	12942	309903	273868	4681	12027	9079	10248	
	2005	243740	99149	88654	42542	4434	8961	316434	274106	4611	13957	8901	14859	
	2010	240258	98353	88494	41504	4193	7714	319916	275458	4554	14437	8786	16681	
	2015	238800	98239	87212	41685	4191	7473	321374	274056	4493	14497	8902	19426	
	2020	238800	98189	89966	42175	3743	4727	321374	274056	4493	14497	8902	19426	
	2023	238407	97905	89820	42228	3766	4688	321374	274056	4493	14497	8902	19426	
MH	1990	293731	187499	78345	9446	8737	9704	199558	148628	17378				33552
	1995	294520	186066	79118	10790	9691	8855	198769	149426	17196				32147
	2000	294534	186444	78910	10775	10124	8281	198755	148695	17177	11528	7140	14215	
	2005	294082	188692	80740	10687	5997	7966	199207	149840	17002	11718	7072	13575	
	2010	293381	188141	80661	10988	6502	7089	199908	149884	18481	11256	6610	13677	
	2015	293328	187910	81376	11388	5845	6809	199961	149884	18495	11279	6610	13693	
	2020	293328	187910	81376	11388	5845	6809	199961	149884	18495	11276	6610	13693	
	2023	293381	188141	80661	10988	6502	7089	199961	149300	18495	11276	6610	13693	
OT	1990	444711	390235	32161	815	8975	12525	105117	57745	17885				29487
	1995	442377	383142	35329	813	10537	12556	107451	57745	17877				31829
	2000	440016	385190	34819	776	9643	9588	109812	58301	17891	19191	9935	4494	
	2005	437165	390569	31022	637	7630	7307	112663	58873	18041	19784	10889	5076	
	2010	434442	388079	31784	529	7634	6416	115386	60172	18390	19971	11209	5644	
	2015	436515	390336	33038	556	7465	5120	113313	57404	17970	20025	11212	6702	
	2020	434442	388079	31784	529	7634	6416	113313	57404	17970	20025	11212	6702	
	2023	434442	388030	31022	660	7630	7100	113313	57404	17970	20025	11212	6702	

County	Year	Agr	A	P	M	V	O	NAgr	F	W	C	R	U	Oth
VL	1990	251656	86724	108234	30344	5480	20874	324821	287429	12395				24997
	1995	250855	86630	111186	30693	4640	17706	325622	287923	12220				25479
	2000	246318	83487	111431	31053	4248	16099	330159	271060	12193	11386	6926	28594	
	2005	245920	87962	108721	31184	4026	14027	330557	290880	12544	11498	6877	8758	
	2010	245680	87836	109581	31538	3761	12964	330797	290880	12544	11825	6877	8671	
	2015	242856	86857	106894	32531	3622	12952	333621	293915	12497	11650	6857	8702	
	2020	250556	86457	113005	34340	3605	13149	333621	293915	12497	11650	6857	8702	
	2023	250377	86321	112966	34340	3605	13145	333621	293915	12497	11650	6857	8702	
Legend: Agr - Agricultural A - Arable P - Pasture				M - Meadows V - Vineyards and hops O - Orchards				NAgr – Non-agricultural F - Forests W - Water land C - Land occupied by construction				R - Roads and railways U - Unproductive land Oth - Other		
Black – Statistical data sourced from the NIS Red – Statistical data sourced from the ANMAP								Blue – Statistical data sourced from the NIS for the year 2014 Green – Values recorded for the most recent known interval						

Source: Own calculation on the basis of data from Tempo online database 1990-2023, NIS

The analysis of the collected data for this period highlights stable trends in certain land use categories, alongside significant changes in others, influenced by socio-economic factors, agricultural policies, the post-communist transition, and Romania's integration into the European Union.

The evolution of land use and land cover in the South-West Oltenia region over the last three decades reveals significant transformations, reflecting both natural processes and anthropogenic interventions. The total area of the region remained constant at 2,921,169 hectares; however, the distribution of land use categories changed considerably between 1990 and 2023, with shifts occurring even between **agricultural and non-agricultural lands** (Figure 2).

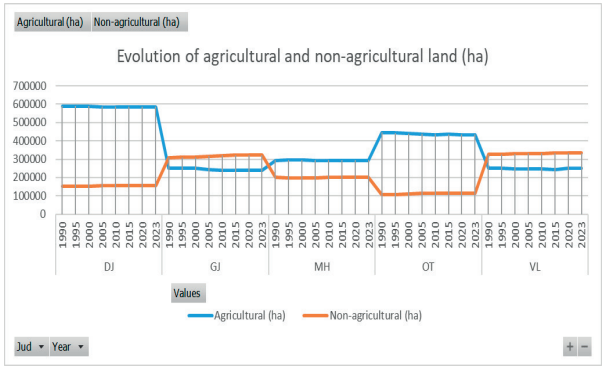


Figure 2. Evolution of agricultural and non-agricultural land between 1990 and 2023

Agricultural lands, representing the most extensive land use category across all five counties, have remained relatively stable in terms of total area. In Dolj and Olt counties, where arable lands constitute the majority of agricultural surfaces, their extent has not undergone significant variations, suggesting the maintenance of an intensive agricultural profile in these lowland areas.

The **arable land area** (Figure 3) in Dolj, for example, remained constant at approximately 488,500 hectares between 2000 and 2023, indicating a well-established mechanized agriculture supported by favorable subsidy policies.

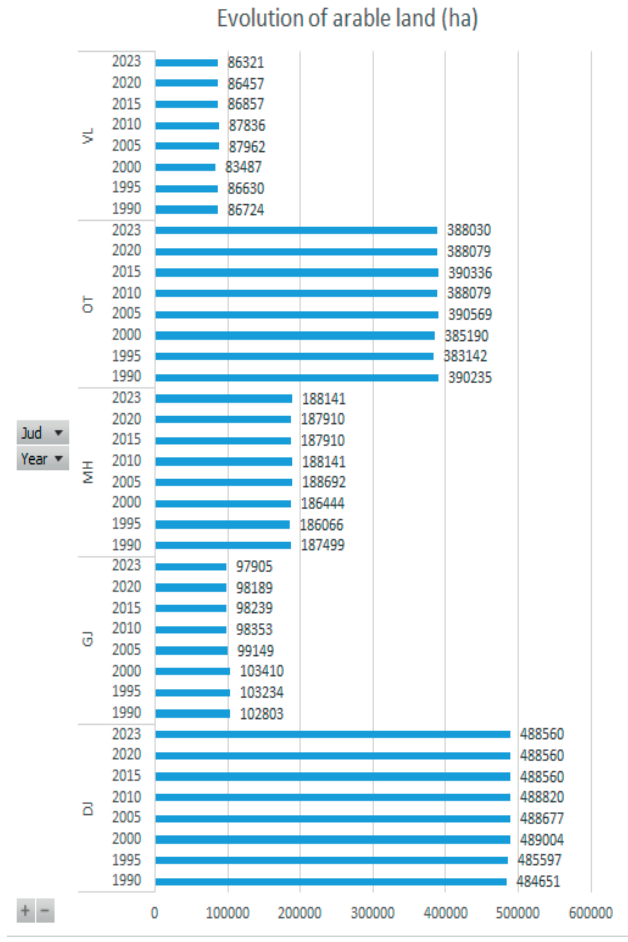


Figure 3. Evolution of arable land between 1990 and 2023

Conversely, in counties with more varied terrain, such as Gorj, Vâlcea, and Mehedinți, agricultural land use experienced slight declines, particularly concerning perennial crops such as **vineyards and orchards** (Figure 4).

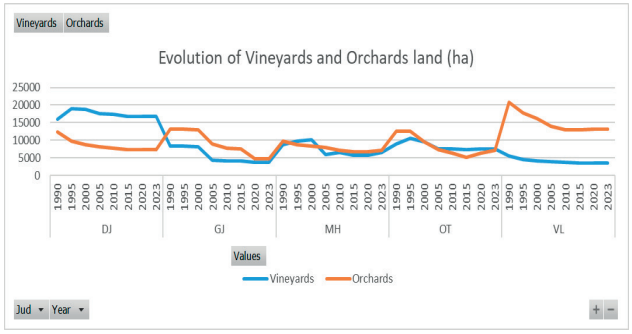


Figure 4. Evolution of Vineyards and Orchards land between 1990 and 2023

In Vâlcea, the area occupied by orchards has significantly decreased compared to 1990, and vineyard areas have been reduced across all analyzed counties. This phenomenon may be associated with the decline of traditional agriculture, especially in hilly and mountainous areas where farming activities are more difficult and costly, and where labor availability has diminished due to migration toward urban centers or abroad.

Pastures and meadows (Figure 5) exhibited variable trends depending on the county. In Gorj and Mehedinți, these areas have been maintained or even slightly expanded during certain intervals, suggesting that grazing remains an important agricultural practice. In contrast, in the lowland counties, pastures have declined, possibly due to conversion to arable land or abandonment.

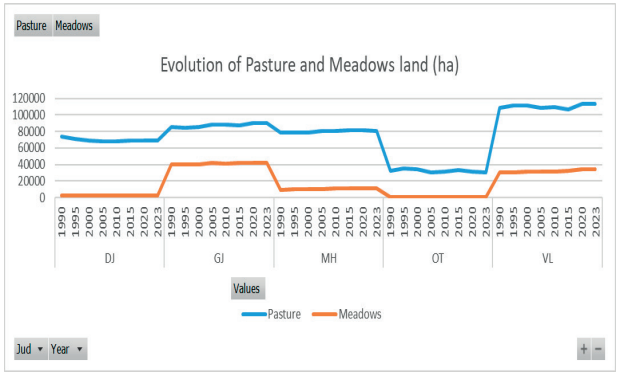


Figure 5. Evolution of Pasture and Meadows land between 1990 and 2023

Forested lands (Figure 6) have generally exhibited a stable or upward trend, especially in the mountainous and submontane counties. Vâlcea, Gorj, and Mehedinți have maintained a high degree of forest cover, with forests occupying approximately 50% of their total area.

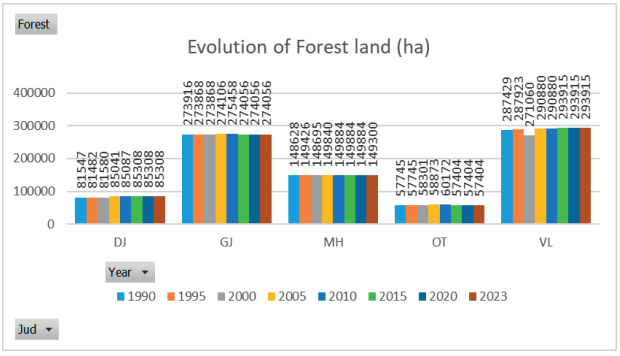


Figure 6. Evolution of Forest land between 1990 and 2023

This stability reflects the effectiveness of forest conservation measures and the fact that these lands are not under significant pressure from urban or agricultural development. In Vâlcea County, for example, forested area increased slightly between 1990 and 2023, reaching over 293,000 hectares, indicating a positive trend in forest resource management.

The built-up land category (Figure 7) experienced a moderate but steady increase across all counties, reflecting urban expansion and infrastructure development. Although the absolute values remain relatively small compared to the total land area, these increases are significant in the context of predominantly rural regions. The area occupied by constructions expanded by approximately 4,500 hectares across the region between 2000 and 2023, particularly in the peri-urban zones of municipalities and in settlements adjacent to county capitals.

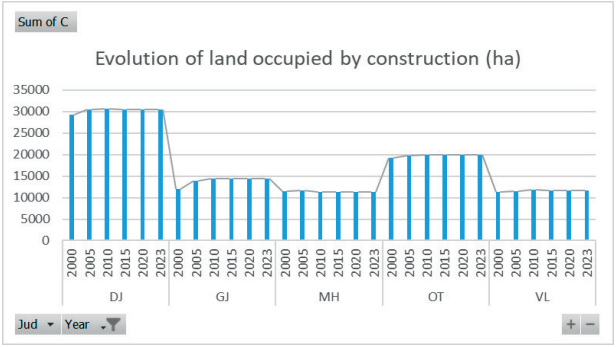


Figure 7. Evolution of land occupied by constructions between 2000 and 2023

At the same time, **road and railway infrastructure** remained relatively constant, even after 2007 when funding opportunities for development projects supported by European funds emerged.

Another relevant aspect concerns **non-productive lands and those classified under "other" uses**. These categories exhibited fluctuating behavior, with a significant regional increase overall. In Mehedinți and Vâlcea counties, a trend toward stabilization or slight decrease was observed, whereas in mining-active counties such as Gorj, the area of non-productive land experienced a sharp increase-nearly doubling. In Dolj and Olt counties, these categories increased slightly, possibly as a result of soil degradation or abandonment of marginal agricultural areas.

The observed changes in the land use structure within the South-West Oltenia region can be explained by a combination of factors. After 1990, the transition from a centralized economy to a market economy led to the fragmentation of agricultural properties (Petrescu et al., 2010) and a period of instability in land use. Subsequently, Romania's accession to the European Union introduced common agricultural policies (Călina et al., 2025; Călina et al., 2023; Petrișor et al., 2020) that significantly influenced land use decisions, especially through subsidies granted for arable lands and pastures. Moreover, the massive emigration of the active population resulted in the abandonment of certain traditional agricultural practices, particularly in mountainous areas, affecting orchards and vineyards in particular.

The South-West Oltenia region presents a complex picture, with a predominance of arable agricultural lands in the south and a strong forest presence in the north and west (Bălteanu et al., 2013; Dogaru et al., 2019). General trends indicate a preservation of the basic land use structure, but with significant adjustments in traditional agricultural forms and slight urban pressure in economically developed areas. These findings are relevant for the formulation of sustainable development policies, resource management, and adaptation to the region's socio-economic and climatic changes (Mocanu et al., 2018).

DISCUSSIONS

The analysis of land use evolution in the South-West Oltenia Region during the period 1990-2023 highlights a series of significant trends, reflecting the socio-economic transition and environmental pressures experienced over the last three decades (Călina et al., 2025; Miluț et al., 2020). Although the total land fund area has remained constant, the internal structure of land use has undergone substantial changes, with direct implications for the sustainability of territorial resource utilization.

One of the most evident trends is **the continuous decline of agricultural lands**, particularly those occupied by orchards and vineyards. These losses can be correlated with rural demographic decline, fragmentation of land ownership, reduced investments in fruit growing and viticulture, as well as the abandonment or conversion of agricultural lands to other uses, including real estate development or non-productive lands. For example, the vineyard area in the region decreased by almost 20% between 1990 and 2023, while orchards experienced an even more pronounced reduction.

In contrast, **the area occupied by forests and forest vegetation has experienced a slight increase**, which can be attributed to reforestation policies and the natural ecological succession occurring in abandoned agricultural areas. However, this trend should be interpreted cautiously, as statistical data do not always reflect the health status of forest ecosystems, which are often affected by illegal logging or inadequate forest management.

The slow expansion of built-up areas and infrastructure suggests peri-urban growth, particularly around major cities such as Craiova and Drobeta-Turnu Severin. Although this urban sprawl is limited compared to other Romanian regions, it may contribute to habitat fragmentation and the loss of productive agricultural land.

A particularly concerning category is represented by degraded and non-productive lands, whose increase signals a significant ecological issue. These lands indicate the occurrence or expansion of processes such as erosion, desertification, soil pollution, or salinization, driven by both natural factors and anthropogenic activities such as overgrazing, deforestation, and mining operations.

Compared to other development regions in Romania, the South-West Oltenia region still maintains a significant share of agricultural land within its total land fund. However, **the increasing conversion of these lands to non-agricultural uses and the decline in**

investments in efficient agriculture may reduce the region's competitiveness in the near future.

The interpretation of land-use dynamics must also be correlated with European agricultural and environmental policies, as well as demographic factors such as rural outmigration and the aging agricultural workforce. Moreover, climate change has the potential to exacerbate existing imbalances, especially in the southern parts of the region where droughts severely affect agricultural productivity.

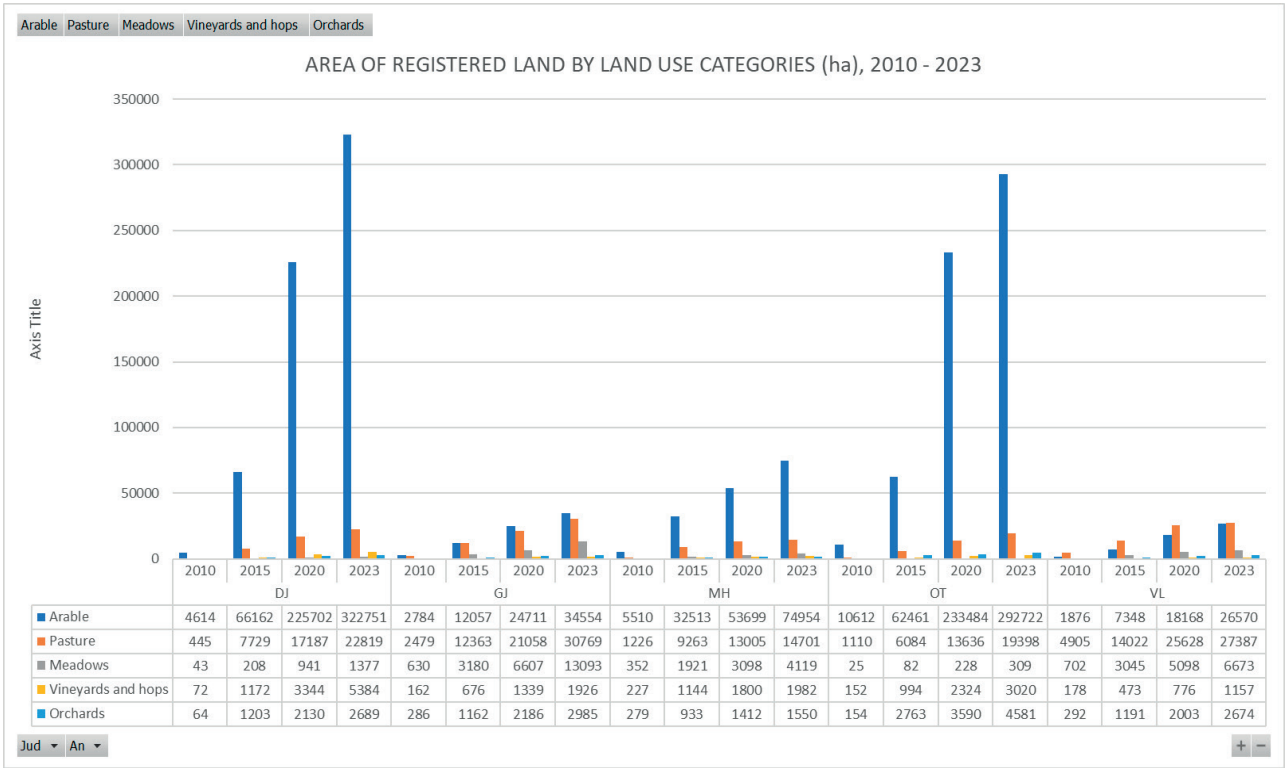
The analyzed data portray a region undergoing a complex transition in land use, with multiple territorial, economic, and ecological implications. Therefore, it is essential that regional planning and public policies consider these trends to promote a sustainable balance between socio-economic development and natural resource conservation.

Methodological Limitations

The primary limitation lies in the aggregated nature of the statistical data, which does not provide parcel-level or micro-territorial details, thereby restricting the spatial resolution of GIS and statistical analyses. Additionally, the lack of continuous annual data for all land-use categories necessitated cautious temporal interpolations to avoid errors. For more precise and detailed analysis, we recommend integrating statistical data with local-level studies in future research.

The accuracy of land use and land cover (LULC) analyses in Romania is directly influenced by the completeness and reliability of available data on land ownership and usage categories. Despite the availability of relevant statistical sources, the quality of results could be significantly improved if the entire national territory were systematically cadastral surveyed.

Figure 8 presents statistics regarding the level of cadastral registration of agricultural land surfaces within the study area for the period 2010-2023 (National Institute of Statistics, 2025).



	DJ				GJ				MH				OT				VL			
	2010	2015	2020	2023	2010	2015	2020	2023	2010	2015	2020	2023	2010	2015	2020	2023	2010	2015	2020	2023
Arable	4614	66162	225702	322751	2784	12057	24711	34554	5510	32513	53699	74954	10612	62461	233484	292722	1876	7348	18168	26570
Pasture	445	7729	17187	22819	2479	12363	21058	30769	1226	9263	13005	14701	1110	6084	13636	19398	4905	14022	25628	27387
Meadows	43	208	941	1377	630	3180	6607	13093	352	1921	3098	4119	25	82	228	309	702	3045	5098	6673
Vineyards and hops	72	1172	3344	5384	162	676	1339	1926	227	1144	1800	1982	152	994	2324	3020	178	473	776	1157
Orchards	64	1203	2130	2689	286	1162	2186	2985	279	933	1412	1550	154	2763	3590	4581	292	1191	2003	2674

Figure 8. Area of registered land by use categories (ha) between 2010 and 2023

A comprehensive registration of properties would allow for detailed knowledge of each land parcel's characteristics, including its designated use, legal status, and temporal changes (Savoiu et al., 2015). However, in Romania, the cadastral process evolved slowly until 2015, when the National Cadastre and Land Registration Program (PNCCF) was launched (Păunescu et al., 2022) with the aim of accelerating the systematic, free registration of all properties.

Although the implementation of this program has led to significant progress, the current coverage level remains below expectations, which continues to limit the capacity for detailed spatial analysis and rigorous support for territorial and environmental planning decisions.
The National Cadastre and Land Registration Program (PNCCF), initiated in 2015, primarily aims to provide free registration of all properties (land and buildings) in the official cadastre and land registry records (ANCPI, 2017). Managed by the National Agency for Cadastre and Real Estate Publicity (ANCPI), the program seeks to clarify property rights, create a unified database, and support economic development through the establishment of clear property records. The process involves topographic measurements, document verification, and the opening of land registry files for each property (ANCPI, 2020; Păunescu et al., 2022). The program is being implemented in thousands of localities nationwide, with priority given to rural areas. PNCCF represents a strategic project for modernizing Romania's property registration system.

CONCLUSIONS

The analysis of land use evolution in the South-West Oltenia region over the period 1990-2023 highlighted several important trends reflecting the socio-economic, demographic, and ecological transformations of the area. Firstly, the total area of the land fund remained relatively constant, indicating that the observed changes are related more to alterations in land use structure and functionality rather than territorial expansion.
From an agricultural perspective, a moderate decline was observed in the areas occupied by orchards and vineyards, while arable lands and pastures showed relative stability, albeit with some local variations recorded across different counties. These dynamics can be attributed to post-1990 agricultural restructuring processes, changes in farming practices, as well as economic and demographic influences that have driven population migration and altered the available rural workforce.
The increase in forested areas and forest vegetation suggests a trend towards recovery or conservation of forest zones, which may have positive effects on regional ecological balance, biodiversity, and soil protection. However, alongside this trend, degraded and unproductive land areas exhibited fluctuations, indicating ongoing challenges related to inadequate land management that require targeted interventions for ecological rehabilitation and prevention of further degradation.
The expansion of built-up areas and infrastructure reflects urban development and growing socio-economic demands, but this process must be carefully monitored to avoid negative impacts on agricultural lands and natural ecosystems. Integrated urban and rural planning is thus essential to ensure sustainable development that balances infrastructure needs with natural resource protection.
The results of this study emphasize the necessity of adopting strategic policies and measures to support sustainable agriculture, environmental conservation, and efficient land use. Investments in modern agricultural technologies, coupled with support measures for farmers and ecological restoration programs for degraded lands, can significantly contribute to increasing productivity and safeguarding natural resources. Concurrently, strengthening the legislative and institutional framework for sustainable land fund management is vital to prevent improper land use and promote a balance between economic development and environmental conservation.
For the South-West Oltenia region, an integrated approach including territorial planning, continuous monitoring of land use, and involvement of local communities will be crucial to ensure balanced development that addresses both present needs and future challenges such as climate change and demographic pressures.

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