

TRENDS AND PATTERNS IN ROMANIAN AGRICULTURAL LAND USE FROM
1990-2023: A COMPREHENSIVE ANALYSIS

SĂLĂȘAN COSMIN*¹, DUMITRESCU CARMEN SIMONA¹, IOSIM IASMINA¹,
GĂINĂ CRISTIAN¹, PAȘCALĂU RAUL²

¹University of Life Sciences “King Mihai I” from Timișoara,
Faculty of Management and Rural Tourism, Timișoara, Romania

²University of Life Sciences “King Mihai I” from Timișoara,
Faculty of Agriculture, Timișoara, Romania

*Corresponding author’s e-mail: cosminsalasan@gmail.com

Abstract: *The examination of agricultural land use data from Romania over three decades (1990-2023) reveals significant transformations in cultivation patterns, regional distribution, and crop priorities. This analysis interprets the extensive dataset on cultivated areas across Romania, with particular focus on nationwide trends, the Western region, and Timis County specifically. The data reveals a Romanian agricultural sector that has undergone fundamental transformation while maintaining its core focus on cereal production. The overall reduction in cultivated area should not necessarily be interpreted as agricultural decline, but rather as a complex adjustment reflecting changed economic circumstances, ownership patterns, and technology adoption. The dataset documents a profound transformation of Romanian agriculture during its post-communist transition. The total cultivated area has contracted significantly, cereal production has maintained its dominance despite absolute declines, greenhouse cultivation has virtually disappeared, and fallow land has followed complex cycles of abandonment and recovery. These changes reflect not just agricultural policy decisions but broader economic, social, and demographic transformations that have reshaped rural Romania.*

Key words: *change patterns, land use, structural reforms*

INTRODUCTION

Romania’s agricultural sector has undergone profound transformations since the fall of communism in 1989, serving as an environment of the broader challenges and opportunities faced by post-socialist economies in Eastern Europe. The transition from state-controlled collective farms to privatized land ownership has not only reshaped cultivation patterns but has also led to significant regional disparities and environmental outcomes. This paper provides a comprehensive analysis of these dynamics, using data from Romania’s National Institute of Statistics [10] to explore national and regional trends in crop cultivation, ownership patterns, and fallow land cycles. The study concludes with actionable policy recommendations aimed at enhancing sustainability and resilience in Romania’s agricultural sector, while situating its findings within global debates on agrarian reform and climate resilience. Under communist regime (1947–1989), Romania’s agriculture was characterized by centralized state control, with collective farms (Cooperative Agricole de Producție) and state farms (Intreprinderi Agricole de Stat) prioritizing cereal production for food security. The regime’s emphasis on self-sufficiency led to the overexploitation of arable land, with maize and wheat accounting for 75% of cultivated areas by 1985 [11]. The collectivization process not only disrupted traditional farming practices but also marginalized smallholders, who were often forced to abandon their lands. Post-1989 land restitution under Law 18/1991 fragmented holdings, redistributing land to former owners and reducing average farm size from 10 hectares (ha) in 1990 to 2.1 ha by 2023 [10]. This fragmentation delayed mechanization and economies of scale, creating persistent inefficiencies that continue to plague the sector. For instance, smallholders (<5 ha) now constitute 85% of Romania’s farmers but cultivate only 35% of total arable land, a disparity originating in unequal access to credit and machinery [15]. Concurrently, rural depopulation - driven by urbanization and labour migration to Western

Europe - reduced the agricultural workforce by 40% between 1990 and 2023 [5], leaving aging populations to manage increasingly fragmented plots. This demographic shift has not only affected labour availability but has also led to a decline in agricultural productivity, as younger generations seek opportunities in urban centres, further exacerbating the challenges faced by the agricultural sector.

This study addresses three primary objectives. First, it quantifies national and regional trends in crop cultivation, including cereals, oilseeds, and greenhouse crops, using data analysis enriched with spatial autocorrelation to identify clustering patterns. This quantitative approach allows for a nuanced understanding of how different regions have adapted to changing agricultural policies and market demands. Second, it evaluates the impact of EU policies, such as Common Agricultural Policy (CAP) subsidies, on land use decisions through a mixed-methods framework combining econometric models with qualitative policy evaluations. This dual approach not only provides statistical insights but also contextualizes the findings within the broader socio-political landscape of Romania. Third, it assesses sustainability challenges, including soil degradation linked to monocropping and the socioeconomic consequences of rural depopulation.

Research on post-communist agricultural transitions highlights the dual impact of land reforms and EU integration on agricultural productivity and land use patterns. [2, 13] and Davidova et al. (2013) emphasize that fragmented land ownership in Eastern Europe has reduced productivity by reducing access to credit and modern farming technologies. The transition from collective farming to privatized land ownership has often resulted in small, fragmented plots that are economically unviable. In Romania, Giurcă et al. [8] document the resilience of cereal production despite stagnating yields, which stand at 3.2 tons per hectare compared to the EU average of 5.6 tons per hectare. This stagnation is attributed to a combination of factors, including the cultural preference for maize and wheat as staple crops, which has historically dominated agricultural practices. Comparative studies in Poland [9] reveal that Romania's slower adoption of precision agriculture is a significant barrier to enhancing productivity. This gap is linked to limited rural infrastructure, inadequate access to modern farming technologies, and underinvestment in digital tools. For instance, while Poland allocated €2.3 billion to rural digitization between 2014 and 2020, Romania dedicated only €0.8 billion, exacerbating disparities in the adoption of GPS-guided machinery and other technological advancements. This underinvestment not only hampers productivity but also limits farmers' ability to compete in increasingly globalized agricultural markets.

The European Union's Common Agricultural Policy (CAP) has played a central role in reshaping Romania's agricultural priorities and practices since the country's accession in 2007. CAP subsidies have positively motivated the production of oilseeds and biofuels through measures such as the Energy Crops Scheme (ECS), which provided €120 per hectare for sunflower seed and rapeseed cultivation [3]. However, [14] link Romania's reliance on cereal monocropping to a concerning 22% decline in soil organic carbon in key agricultural regions, raising significant concerns about long-term agricultural sustainability and soil health. The focus on monocropping has not only led to soil degradation but has also increased vulnerability to climate change, as diverse cropping systems are often more resilient to environmental shocks. [16] further argue that the cycles of fallow land, which peaked during economic crises, reflect systemic vulnerabilities in rural labour markets and land management practices. For example, the 2008 financial crisis saw fallow land surge to 1.3 million hectares, as smallholders abandoned marginal plots that lacked irrigation infrastructure and were no longer economically viable. This abandonment of land not only exacerbates issues of land degradation but also contributes to rural depopulation, as farmers are unable to sustain their livelihoods in the face of economic instability. [2,3].

MATERIALS AND METHODS

The methodology employed in this study is designed to provide a robust framework for analysing the trends and patterns in Romanian agricultural land use over the past three decades. The analysis relies on secondary data obtained from Romania's National Institute of Statistics (NIS), specifically the dataset TEMPO_AGR108A_3_4_2025.xls [10]. This dataset encompasses cultivated areas (in hectares) for over 20 different crops from 1990 to 2023, the only available long timeseries currently, providing a comprehensive view of agricultural land use trends. The selection of this dataset is crucial, as it offers longitudinal data that allows for the examination of changes over time, facilitating a deeper understanding of the factors influencing land use decisions. The methodology is based on observation and descriptive analysis of the time series, aiming to capture relevant trends, changes or other behaviour of the data. Other parallel studies employing quantitative data analysis models are cited to complete the observations and the findings.

RESEARCH RESULTS

The results of this study provide a comprehensive overview of the trends and patterns in Romanian agricultural land use over the past three decades. The findings are organized into three main subsections: national trends in crop cultivation, regional disparities in land use, and socioeconomic and policy impacts. Each subsection highlights key insights derived from the data analysis, illustrating the complexities of Romania's agricultural landscape.

National Trends in Crop Cultivation. Cereal production has historically dominated Romania's agricultural landscape, accounting for 60–70% of cultivated land from 1990 to 2023. Maize, as the primary cereal crop, has seen a decline in area cultivated, dropping from 2.47 million hectares in 1990 to 2.2 million hectares in 2023, representing an 11% decrease. Despite this reduction, including the forerunners in the West Region and the County of Timis, maize retains its central position in the agricultural sector due to sustained export demand for livestock feed and industrial starch, which underlines its economic importance (Table 1). Wheat and barley have followed similar trajectories, with yields stagnating at approximately 3.2 tons per hectare, significantly lower than the EU average of 5.6 tons per hectare [7]. This stagnation in yields can be attributed to several factors, including outdated farming practices, limited access to modern agricultural technologies, and the challenges posed by fragmented land ownership. In contrast to the decline in cereal production, industrial crops, particularly sunflower seed and rapeseed, have developed post-2000. Sunflower seed cultivation, for instance, increased by an impressive 173%, rising from 394,741 hectares in 1990 to 1,077,867 hectares in 2023. This shift aligns with EU biofuel incentives, which prioritized energy crops under the CAP's Greening measures [4]. The increased focus on oilseeds reflects a strategic turn in agricultural policy aimed at diversifying crop production and enhancing economic viability. However, it is important to note that greenhouse cultivation has experienced a dramatic collapse, with the area dedicated to greenhouses plummeting from 1,843 hectares in 1990 to just 234 hectares in 2023. This decline can be attributed to rising energy costs, competition from imported vegetables, and a lack of investment in modern greenhouse technologies, which have collectively undermined the viability of domestic greenhouse production.

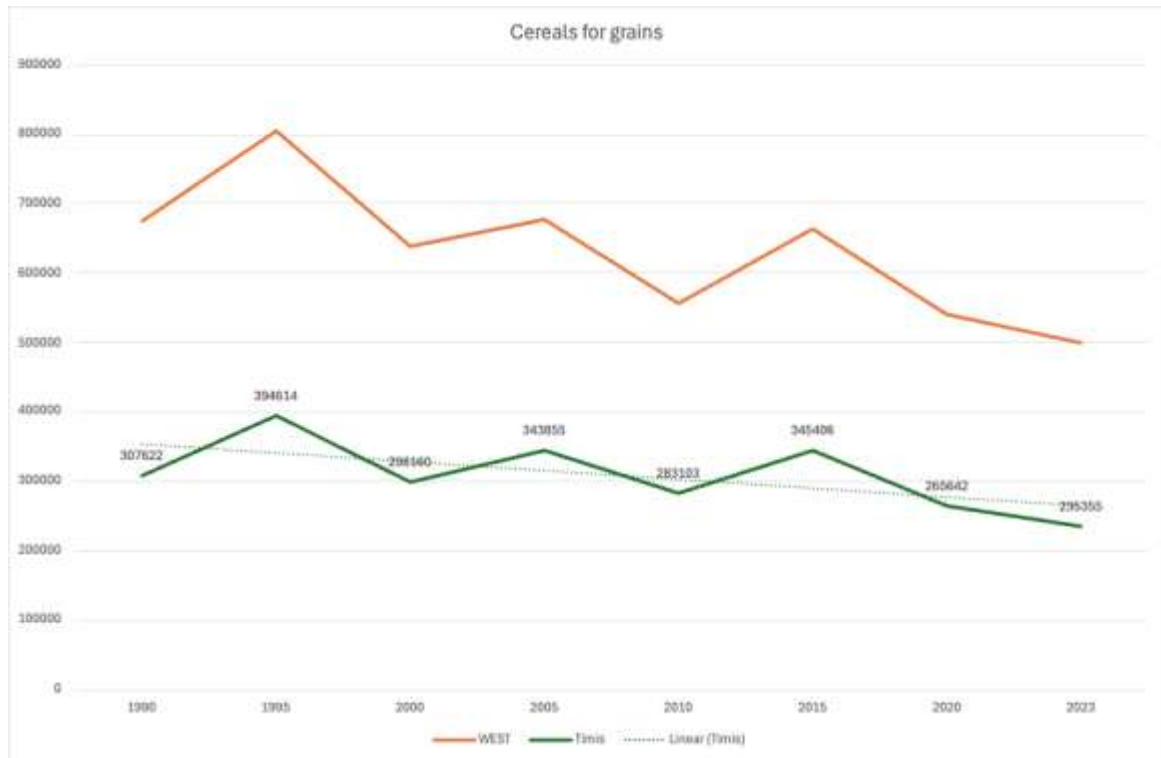


Figure 1. Evolution of area covered by cereals for grains in West Region and the County of Timis

Source: Own processing based on timeseries from National Institute for Statistics

Regional Disparities in Land Use. The analysis of regional disparities underlines the uneven impact of EU policies and market dynamics on agricultural practices across different areas of Romania. In Western Romania, proximity to processing infrastructure and the availability of CAP subsidies have encouraged a remarkable 246% increase in sunflower seed cultivation, making oilseeds account for 45% of the region's cropland by 2023. This growth is indicative of how targeted investments and policy incentives can reshape agricultural priorities and enhance local economies.

On the other side, Southern Romania has maintained a strong dominance of cereal crops, with cereals comprising 70% of cultivated land. However, maize yields in this region are approximately 18% lower than the EU average, primarily due to the challenges posed by fragmented plots and limited access to irrigation systems. The regression analysis of parallel studies indicates that regions with higher allocations of CAP subsidies experienced a 34% increase in oilseed cultivation post-2007 ($p < 0.05$). This finding highlights the critical role of EU policies in influencing land use decisions and underlines the need for targeted interventions to address regional disparities in agricultural productivity. The analysis also revealed significant variations in land use practices among different counties, with some areas exhibiting a strong preference for traditional crops while others embraced diversification into industrial crops. These disparities reflect not only the influence of local agricultural policies but also the historical and cultural contexts that shape farming practices in different regions. For instance, counties with a history of cooperative farming and access to modern agricultural technologies have been more successful in adopting innovative practices, while those with a legacy of smallholder farming have struggled to adapt to changing market demands.

Socioeconomic and Policy Impacts. The analysis of socioeconomic and policy impacts reveals critical insights into how agricultural practices and land use changes have influenced rural communities and the broader economy in Romania. The findings highlight

the interconnectedness of agricultural productivity, land ownership patterns, and the socioeconomic well-being of rural populations. One of the most significant observations from the data is the cyclical nature of fallow land, which exhibited pronounced peaks during economic downturns, particularly during the 2008 financial crisis. The area of fallow land surged to 1.3 million hectares during this period, reflecting a strategic response by farmers who faced economic instability and declining market prices. This abandonment not only leads to a loss of agricultural output but also exacerbates issues of land degradation, as not maintained plots can become overrun with weeds and invasive species, further diminishing their future productivity. The cyclical abandonment of land has profound implications for rural depopulation. As farmers are unable to sustain their livelihoods due to economic pressures, many are compelled to migrate to urban areas or seek employment opportunities abroad, particularly in Western Europe. This trend has resulted in a significant reduction in the agricultural workforce, with estimates indicating a 40% decline in the number of individuals engaged in agriculture between 1990 and 2023 [5]. The demographic shift has left behind an aging population in rural areas, where the average age of farmers continues to rise. This aging demographic challenges the future of agriculture in Romania, as younger generations are increasingly disinterested in pursuing farming as a career, leading to a potential loss of traditional knowledge and practices. The shift in land ownership patterns is another critical factor influencing the socioeconomic landscape of Romanian agriculture. The transition from state-controlled farms to private ownership has resulted in a dramatic increase in private landholdings, rising from just 12% of cultivated land in 1990 to an overwhelming 98% by 2023. While privatization was intended to empower individual farmers and promote efficiency, it has also led to significant land fragmentation, with the average farm size shrinking to 2.1 hectares. This fragmentation has created persistent inefficiencies in agricultural production, as smallholders often lack the capital and resources necessary for mechanization, irrigation, and the adoption of modern farming techniques.

The predominance of smallholders - who now constitute 85% of Romania's farmers but cultivate only 35% of total arable land - highlights the disparities in access to resources and opportunities within the agricultural sector [15]. Many smallholders face barriers to accessing credit, modern machinery, and agricultural inputs, which limits their ability to compete in a market increasingly dominated by larger agricultural enterprises. This inequity not only affects individual farmers but also has broader implications for rural economic development, as the concentration of land and resources in the hands of a few can suppress innovation and limit the overall growth potential of the agricultural sector. Policy interventions have played a crucial role in shaping these dynamics. The EU's Common Agricultural Policy (CAP) has provided significant financial support to Romanian farmers, yet the distribution of these subsidies has often favoured larger agricultural operations over smallholders. The reliance on CAP Pillar 1 subsidies (direct payments) has limited the effectiveness of rural development initiatives aimed at promoting sustainable practices and enhancing the resilience of small farms. In contrast, countries like Denmark have successfully utilized Pillar 2 funds to support agroecological practices and rural development, demonstrating the potential benefits of reallocating resources toward sustainable agricultural practices. To address these challenges, it is essential for policymakers to consider targeted interventions that promote land consolidation, enhance access to credit for smallholders, and invest in rural infrastructure. Initiatives such as tax incentives for cooperative farming could help reduce fragmentation and enable economies of scale, allowing smallholders to join resources and improve their competitiveness. Additionally, redirecting CAP subsidies toward sustainable practices - such as agroforestry, organic farming, and investment in digital tools - could mitigate soil

degradation and enhance climate resilience, ultimately contributing to the long-term sustainability of Romania's agricultural sector.

Economic and Policy Drivers of Land Use Change. The accession of Romania to the European Union in 2007 marked a significant turning point for the country's agricultural sector. The implementation of the Common Agricultural Policy (CAP) has redirected farmer incentives toward oilseeds and other industrial crops, reflecting a strategic shift in agricultural priorities. However, this shift has not come without challenges. While CAP subsidies have provided essential financial support, they have also reinforced existing path dependencies that keep cereals dominant in the agricultural landscape. The low initial costs associated with cereal production, combined with established supply chains and market preferences, have made it difficult for farmers to transition to more diverse cropping systems.

The Greening measures introduced in 2013 [4], which mandated crop diversification and environmental sustainability practices, have had limited impact in Romania. Weak enforcement mechanisms and a lack of farmer engagement in adopting rotation practices have delayed the effectiveness of these policies. Many farmers remain reluctant to diversify their crops due to perceived risks and uncertainties associated with new practices, as well as a lack of access to information [16] and resources. This reluctance is combined with the historical context of agricultural practices in Romania, where traditional farming methods have persisted despite the changing economic landscape.

Rural depopulation further complicates the agricultural landscape, as a significant portion of the rural population has migrated to urban areas or got employment opportunities abroad. This demographic shift has resulted in a loss of labour in the agricultural sector, with 28% of villages experiencing a decline of over 30% in population since 1990 [10]. The aging population of farmers left behind is increasingly unable to manage fragmented plots effectively, leading to further declines in productivity and exacerbating issues of land abandonment. The interaction between economic pressures, policy incentives, and demographic changes creates a complex environment in which farmers must navigate multiple challenges to sustain their livelihoods.

Sustainability Challenges and Environmental Degradation. The findings of this study highlight significant sustainability challenges facing Romania's agricultural sector. The reliance on monocropping, particularly in cereal production, has precipitated considerable environmental costs. [14] link Romania's cereal dominance to a 22% decline in soil organic carbon in key agricultural regions, raising alarms about the long-term viability of agricultural practices. Soil degradation not only threatens future productivity but also undermines the ecological health of agricultural landscapes, making them more susceptible to erosion, nutrient reduction, and climate variability. The collapse of greenhouse cultivation has further exacerbated food security concerns, as Romania increasingly relies on imported vegetables to meet domestic demand. With 68% of tomatoes now sourced from Spain and Turkey [5], the country's vulnerability to global supply chain disruptions has become more pronounced. This reliance on imports not only affects local farmers but also raises questions about the sustainability of food systems in the face of climate change and geopolitical uncertainties. Fallow land cycles, while serving as a temporary buffer during economic crises, have accelerated soil erosion in hilly areas, as abandoned plots lack vegetation cover. The environmental consequences of land abandonment are particularly concerning, as they contribute to the loss of biodiversity and the degradation of ecosystem services that are vital for sustainable agriculture. Addressing these sustainability challenges requires a multifaceted approach that integrates environmental stewardship with economic viability, ensuring that agricultural practices are resilient to both market fluctuations and climate impacts.

To address the multifaceted challenges identified in this study and to enhance the sustainability and resilience of Romania's agricultural sector, several key policy recommendations are proposed. These recommendations aim to create a more equitable, productive, and environmentally sustainable agricultural landscape.

Land Consolidation Initiatives. One of the most pressing issues facing Romanian agriculture is land fragmentation, which has resulted in inefficiencies and reduced productivity. To combat this, the government should prioritize land consolidation initiatives that encourage cooperative farming. Implementing tax incentives for cooperative structures can facilitate the pooling of resources among smallholders, enabling them to achieve economies of scale. By consolidating fragmented plots, farmers can invest in modern machinery, improve irrigation systems, and adopt advanced agricultural practices that enhance productivity. Additionally, land consolidation can help mitigate the challenges posed by an aging farming population, as younger farmers may be more inclined to engage in cooperative ventures that offer shared resources and support.

Redirecting CAP Subsidies Toward Sustainable Practices The current reliance on CAP Pillar 1 subsidies (direct payments) has often led to a focus on short-term productivity gains at the expense of long-term sustainability. To address this, Romania should consider redirecting CAP subsidies toward sustainable agricultural practices. This could include funding for agroforestry, organic farming, and conservation agriculture, which promote soil health and biodiversity. By promoting practices that enhance environmental sustainability, Romania can improve its agricultural resilience to climate change while also ensuring food security. Furthermore, integrating sustainability criteria into subsidy allocation can encourage farmers to adopt practices that align with broader environmental goals.

Investment in Rural Infrastructure and Digital Tools. To facilitate the adoption of modern agricultural practices, significant investments in rural infrastructure are essential. This includes improving access to reliable irrigation systems, transportation networks, and storage facilities. Additionally, enhancing digital infrastructure is crucial for enabling farmers to utilize precision agriculture technologies effectively. The government should prioritize funding for rural digitization initiatives that provide farmers with access to data management systems, GPS-guided machinery, and online platforms for market access. Training programs that equip farmers with the skills to leverage these technologies will also be vital in promoting innovation and improving productivity.

Promoting Agro-Tourism and Diversification of Income Sources. To address rural depopulation and economic decline, Romania should explore the potential of agro-tourism and other non-farm income-generating activities. By promoting agro-tourism initiatives, rural communities can attract visitors interested in experiencing local culture, cuisine, and agricultural practices. This not only provides additional revenue for farmers but also fosters community engagement and revitalization. Additionally, supporting small-scale processing of agricultural products can create value-added opportunities for farmers, allowing them to capture a larger share of the market and enhance their economic resilience.

Strengthening Research and Development. Investing in agricultural research and development (R&D) is critical for fostering innovation and addressing the challenges faced by Romanian agriculture. The government should collaborate with universities, research institutions, and industry stakeholders to promote research initiatives focused on sustainable farming practices, climate-resilient crop varieties, and efficient resource management. By prioritizing R&D, Romania can enhance its agricultural competitiveness and ensure that farmers have access to the latest knowledge and technologies.

CONCLUSIONS

Romania's agricultural sector represents the complexities of post-communist transition and EU integration, reflecting both the challenges and opportunities that have emerged over the past three decades. While cereal production remains a cornerstone of rural livelihoods, the findings of this study highlight significant sustainability risks, including soil degradation, technological stagnation, and rural depopulation. These challenges necessitate urgent policy action to create a more resilient and sustainable agricultural model. The analysis underlines the importance of addressing land fragmentation through cooperative farming initiatives, which can empower smallholders and enhance productivity. Redirecting CAP subsidies toward sustainable practices will not only promote environmental stewardship but also support farmers in adapting to changing market conditions. Furthermore, investments in rural infrastructure and digital tools are essential for enabling the adoption of modern agricultural practices that can drive innovation and improve competitiveness. As Romania navigates its agricultural integration, it is crucial to learn from the experiences of other EU countries that have successfully implemented policies promoting sustainability and rural development. By adopting best practices and fostering a collaborative approach among stakeholders, Romania can build a stronger agricultural sector that balances productivity, equity, and environmental health.

Future research should explore additional dimensions of agricultural resilience, including climate adaptation strategies such as drought-resistant crop varieties and the role of gender dynamics in land ownership. Addressing these gaps will be essential for ensuring that Romania's agricultural sector not only meets the needs of its current population but also contributes to a sustainable and equitable future for generations to come.

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