ASSESSING THE IMPACT OF AGRI-ENVIRONMENTAL PAYMENTS ON THE DYNAMICS OF PERMANENT GRASSLANDS IN HUNEDOARA COUNTY, ROMANIA

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Abstract

Permanent grasslands represent one of the most valuable components of agricultural landscapes in Romania, providing essential ecosystem services, supporting biodiversity conservation, and maintaining the ecological stability of rural areas. In recent decades, changes in agricultural policies and the implementation of agri-environmental payment schemes under the Common Agricultural Policy (CAP) have significantly influenced the management and conservation of these ecosystems. This study assesses the impact of agri-environmental payments on the dynamics of permanent grasslands in Hunedoara County, Romania, with particular emphasis on their spatial distribution, management patterns, and conservation status.

The research was based on the analysis of agricultural and environmental datasets, GIS mapping, and the evaluation of grassland areas included in different agri-environmental support schemes. The distribution of permanent grasslands was examined in relation to subsidy uptake, management intensity, and the occurrence of potential abandonment processes. The results indicate that areas benefiting from agri-environmental payments generally exhibit a higher degree of grassland preservation and a lower risk of abandonment compared to areas with limited participation in support schemes. Furthermore, the spatial analysis revealed significant differences in the distribution of grassland systems according to topographical conditions and the type of agri-environmental measures implemented.

The findings highlight the important role of agri-environmental payments in maintaining permanent grasslands and supporting sustainable land-use practices in Hunedoara County. Continued financial support, combined with effective monitoring and targeted management measures, is essential for preserving the ecological and socio-economic functions of these valuable grassland ecosystems.

Keywords: *ermanent grasslands, agri-environmental payments, Common Agricultural Policy, grassland dynamics, GIS analysis, grassland conservation, Hunedoara County.*

INTRODUCTION

Permanent grasslands are among the most valuable agricultural ecosystems in Europe, providing essential ecosystem services such as forage production, biodiversity conservation, carbon sequestration, soil protection, water regulation, and the maintenance of traditional cultural landscapes (Habel et al., 2013; Dengler et al., 2014; Rotar et al., 2020). Semi-natural grasslands are particularly important because they support a high diversity of plant and animal species and represent some of the most species-rich habitats in the European agricultural landscape (Pärtel & Zobel, 1999; Wilson et al., 2012; Vaida et al., 2021).

During the last century, however, semi-natural grasslands have experienced substantial declines in both area and ecological quality as a consequence of agricultural intensification, land-use change, and abandonment of traditional management practices (Stoate et al., 2001; Dahlström et al., 2006; Cousins et al., 2015). These processes have led to habitat fragmentation, biodiversity loss, shrub encroachment, and the degradation of ecosystem services associated with extensively managed grasslands (Pykälä, 2004; Öckinger et al., 2006; Păcurar et al., 2020). As a result, the conservation of permanent grasslands has become a major objective of European environmental and agricultural policies.

To address these challenges, the European Union introduced agri-environmental schemes (AES) within the Common Agricultural Policy, aiming to encourage farming practices compatible with biodiversity conservation and sustainable land management (Kleijn & Sutherland, 2003; Batáry et al., 2015). These schemes provide financial support for maintaining grazing or mowing regimes, limiting agricultural intensification, and preserving habitats of high conservation value. Nevertheless, the effectiveness of agri-environmental measures remains a subject of scientific debate, as positive effects on biodiversity are not always consistent across regions, taxa, or management systems (Kleijn et al., 2001; Pe'er et al., 2014; Berg et al., 2019).

Romania hosts some of the largest remaining areas of semi-natural grasslands in Europe and is recognized as a stronghold for High Nature Value (HNV) farming systems (Babai & Molnár, 2014; Rotar et al., 2020; Vaida et al., 2021). These grasslands are characterized by high floristic diversity, extensive management practices, and important socio-economic functions for rural communities. Through the Rural Development Programme (RDP

2014–2020) and the National Strategic Plan (NSP 2023–2027), Romania has implemented several agri-environmental measures intended to support the conservation and sustainable management of permanent grasslands (PNDR, 2019; PNS, 2023).

Despite the increasing financial resources allocated through agri-environmental payments, relatively few studies have evaluated their spatial distribution and potential contribution to grassland conservation at regional level in Romania. Understanding the relationship between agricultural support measures and permanent grassland dynamics is particularly important in mountainous and hilly regions, where both agricultural abandonment and management intensification can significantly influence ecosystem integrity and landscape structure.

Following the reform of the Common Agricultural Policy (CAP) for the 2023–2027 programming period, the support system for permanent grasslands in Romania has been substantially restructured through the integration of direct payments, eco-schemes, and agri-environment-climate interventions. Permanent grasslands cover approximately 4.8–4.9 million hectares nationally and represent a key component of both agricultural production systems and biodiversity conservation strategies. The current support framework combines the Basic Income Support for Sustainability (BISS), the Complementary Redistributive Income Support for Sustainability (CRISS), support for young farmers (CIS-YF), voluntary eco-schemes, and rural development interventions targeting environmentally valuable grassland systems. All payments are linked to the fulfilment of conditionality requirements, including Good Agricultural and Environmental Conditions (GAEC) and Statutory Management Requirements (SMR), with particular emphasis on the protection of permanent grasslands located within Natura 2000 sites.

Among the available interventions, agri-environment-climate support for permanent grasslands (DR-01) plays a particularly important role in promoting sustainable management practices and conserving High Nature Value (HNV) grasslands. These measures provide compensation for income forgone and additional management costs associated with biodiversity-friendly practices, including restrictions on fertilizer and pesticide use, delayed mowing dates, maintenance of uncut strips, grazing intensity requirements, and habitat-specific conservation measures. Several packages specifically target species and habitats of European conservation concern, such as *Crex crex*, *Maculinea butterflies*, and Aquila pomarina. Through these interventions, agricultural support

policies aim not only to maintain agricultural activity but also to reduce land abandonment and preserve the ecological integrity of permanent grassland ecosystems.

Hunedoara County represents a relevant study area because of its extensive grassland resources, diverse environmental conditions, and significant participation in agri-environmental support schemes. Evaluating the distribution of permanent grasslands in relation to agri-environmental payments can provide valuable information regarding the effectiveness of current policy instruments and their contribution to sustainable grassland management.

Therefore, the aim of this study was to assess the relationship between agri-environmental payments and the dynamics of permanent grasslands in Hunedoara County, Romania. The objectives were: (i) to analyze the spatial distribution of permanent grasslands; (ii) to evaluate the distribution of agri-environmental payment schemes; (iii) to identify areas potentially exposed to management changes or abandonment; and (iv) to assess the contribution of agri-environmental support measures to the conservation of permanent grasslands.

MATERIALS AND METHODS

Study Area

The study was conducted in Hunedoara County, located in the western-central part of Romania. The county covers approximately 7,063 km² and is characterized by a complex relief structure comprising mountain, hill, and depression landscapes. Mountain areas occupy a significant proportion of the territory, creating favorable conditions for the development of extensive livestock farming systems and permanent grasslands.

Permanent grasslands represent an important component of the agricultural land fund of Hunedoara County, being distributed across both mountain and hilly regions. Due to their ecological importance and extensive management, a considerable proportion of these grasslands are eligible for support through agri-environmental and climate interventions implemented under the Common Agricultural Policy (CAP).

Data Sources

The study was based on agricultural, administrative, and spatial datasets related to the implementation of support schemes for permanent grasslands.

Information regarding agricultural support measures was obtained from official documents of the Ministry of Agriculture and Rural Development (MADR), the Agency for Payments and Intervention in Agriculture (APIA), the National

Strategic Plan 2023–2027 (NSP), and the Rural Development framework applicable to permanent grasslands. Particular attention was given to interventions available for grassland management, including:

- Basic Income Support for Sustainability (BISS – PD-01);
- Complementary Redistributive Income Support for Sustainability (CRISS – PD-02);
- Support for Young Farmers (CIS-YF – PD-03);
- Eco-schemes applicable to grassland systems (PD-05);
- Agri-environment and climate intervention for permanent grasslands (DR-01).

Spatial information regarding the distribution of permanent grasslands was obtained from geospatial datasets used for agricultural land management and territorial analysis. Administrative boundaries, land-use layers, and thematic maps were integrated into a Geographic Information System (GIS) environment.

Classification of Grassland Support Systems

For the purpose of the study, the support instruments available for permanent grasslands were grouped into three major categories:

1. Direct income support schemes (BISS, CRISS and CIS-YF);
2. Eco-schemes promoting environmentally friendly management practices;
3. Agri-environment and climate interventions targeting High Nature Value (HNV) grasslands and habitats of conservation interest.

Special emphasis was placed on DR-01 interventions, as these measures are directly linked to biodiversity conservation objectives and include specific management requirements such as extensive grazing, delayed mowing, restrictions on chemical inputs, and habitat protection measures.

Evaluation of Agri-Environmental Support

The assessment of agri-environmental support was based on the analysis of eligibility conditions, management requirements, and environmental objectives associated with the main grassland interventions.

Particular attention was given to the DR-01 intervention, which supports High Nature Value grasslands and habitats associated with species of European conservation concern. The analysis considered management requirements related to grazing intensity, mowing dates, restrictions on fertilizer and pesticide use, maintenance of ecological structures, and long-term commitments undertaken by beneficiaries.

The role of these measures was evaluated in relation to their potential contribution to biodiversity conservation, sustainable grassland management, and the prevention of land abandonment.

RESULTS AND DISCUSSION

Evolution of Land Use Categories and Permanent Grasslands in Hunedoara County

The analysis of land-use dynamics during the 2015–2023 period revealed significant structural changes in the agricultural landscape of Hunedoara County. Arable land (TA) increased steadily throughout the study period, indicating a gradual intensification of agricultural production and a more efficient utilization of available agricultural resources. This trend was accompanied by a continuous reduction in non-productive arable land (TAn), suggesting the conversion of previously underutilized areas into productive agricultural land.

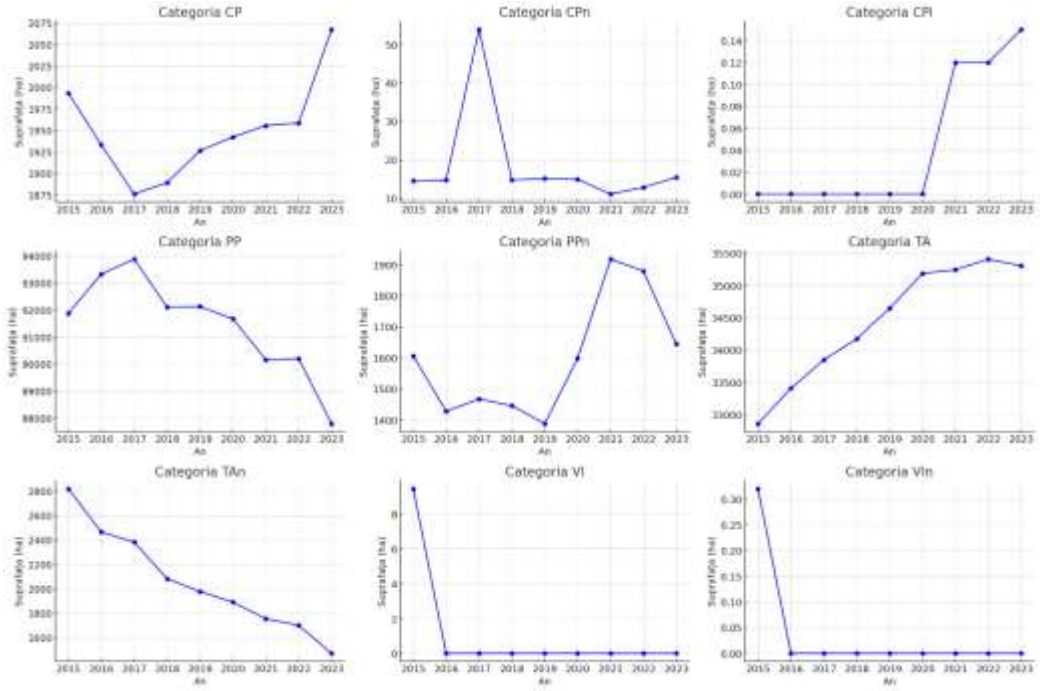
Permanent grasslands (PP) remained the dominant land-use category across the entire study period, confirming their crucial role within the agricultural systems of Hunedoara County. However, after reaching a maximum in 2017, grassland areas exhibited a gradual decline, particularly after 2020 (Figure 1). The overall reduction in permanent grassland area may reflect increasing pressures associated with land-use change, reduced grazing activity, and agricultural restructuring. Nevertheless, the relatively moderate decline observed over the study period indicates a certain degree of resilience of grassland systems.

The dynamics of non-productive permanent grasslands (PPn) showed marked fluctuations, with a notable increase during 2020–2021, followed by a subsequent decline. This pattern may indicate temporary abandonment processes or changes in management intensity, influenced by economic conditions, agricultural policies, or climatic variability.

Permanent crops (CP) displayed a positive trend after 2018, suggesting renewed investments in orchards and other perennial production systems, while vineyards (VI) and non-productive vineyards (VIn) occupied only marginal areas and had a negligible influence on overall land-use dynamics.

Overall, the results indicate a gradual intensification of agricultural land use, characterized by the expansion of arable land and the reduction of non-productive surfaces. Despite these changes, permanent grasslands remained the predominant agricultural land-use

category in Hunedoara County, highlighting their continued ecological and economic importance. The persistence of extensive grassland systems throughout the study period suggests that agri-environmental payments and CAP support measures may have contributed to limiting grassland conversion and maintaining the multifunctional role of these ecosystems in the regional landscape.



TA – arable land; TAn – non-productive arable land; PP – permanent grasslands; PPn – non-productive permanent grasslands; CP – permanent crops; CPn – non-productive permanent crops; CPi – irrigated permanent crops; VI – vineyards; VIn – non-productive vineyards.

Fig. 1 Evolution of agricultural land-use categories in Hunedoara County during the period 2015–2023

EVOLUTION OF PERMANENT GRASSLAND AREAS ENROLLED IN AGRI-ENVIRONMENTAL SUPPORT SCHEMES

The analysis of agri-environmental grassland management types revealed distinct temporal patterns between 2015 and 2019, reflecting both farmers' responses to support schemes and the progressive implementation of CAP-related environmental measures.

A1 – Grazing Management

The evolution of grassland areas included under the A1 grazing

management category showed a sustained increase between 2015 and 2018, followed by a period of relative stabilization in 2019. This trend suggests an initial expansion of participation in grazing-related support schemes, likely associated with farmers' adaptation to agri-environmental requirements and increasing awareness of available financial incentives. The subsequent stabilization may indicate the attainment of a management equilibrium, where most eligible grassland areas had already been incorporated into the support system. From an institutional perspective, the observed pattern reflects the gradual alignment of local farming systems with CAP objectives promoting sustainable grazing practices and grassland conservation.

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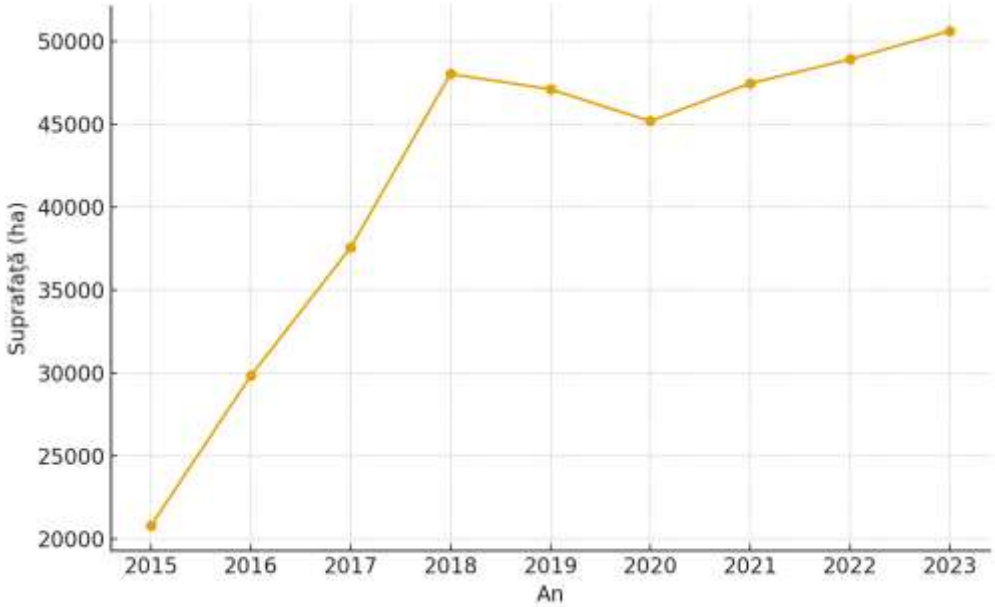

Fig. 2 Evolution of grassland areas under the A1 grazing management category during the period 2015–2019

A2 – Traditional Mowing Management

The A2 category, corresponding to manually mown grasslands, exhibited a continuous and nearly linear increase throughout the entire study period. This positive trend indicates a growing adoption of management practices compatible with biodiversity conservation objectives. The acceleration observed after 2017 may be linked to increased participation in agri-environmental schemes and to adjustments introduced during the CAP transition period. From a socio-economic perspective, the results suggest that traditional mowing systems became increasingly

attractive for farmers, providing both environmental benefits and supplementary income through agri-environmental payments. The maintenance of manually managed grasslands is particularly important for preserving floristic diversity and sustaining High Nature Value (HNV) farming systems.

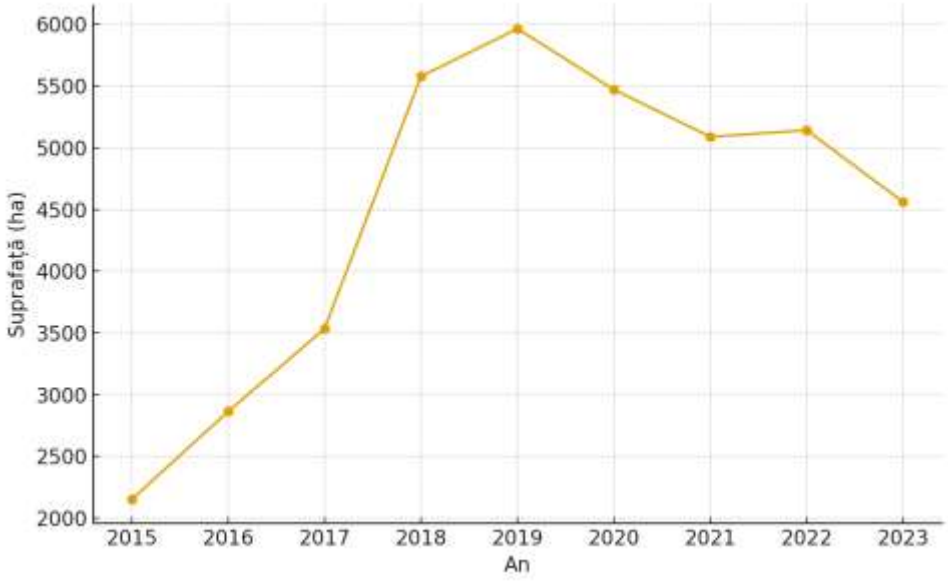

Fig. 3 Evolution of grassland areas under the A2 traditional mowing management category during the period 2015–2019

A3 – Mechanized Mowing Management

The A3 category showed the most pronounced increase among all analyzed management types. Grassland areas managed through mechanized mowing expanded rapidly between 2015 and 2019, displaying an almost exponential growth pattern. This substantial increase may reflect both the improved accessibility of grassland areas and the growing capacity of farmers to comply with management requirements while maintaining economic viability. The observed expansion could also be associated with the implementation of targeted support measures encouraging the inclusion of previously underutilized grassland areas into formal agricultural management systems. The strong response of this category highlights the sensitivity of farmers to economic incentives and demonstrates the significant influence of agri-environmental payments on management decisions at farm level

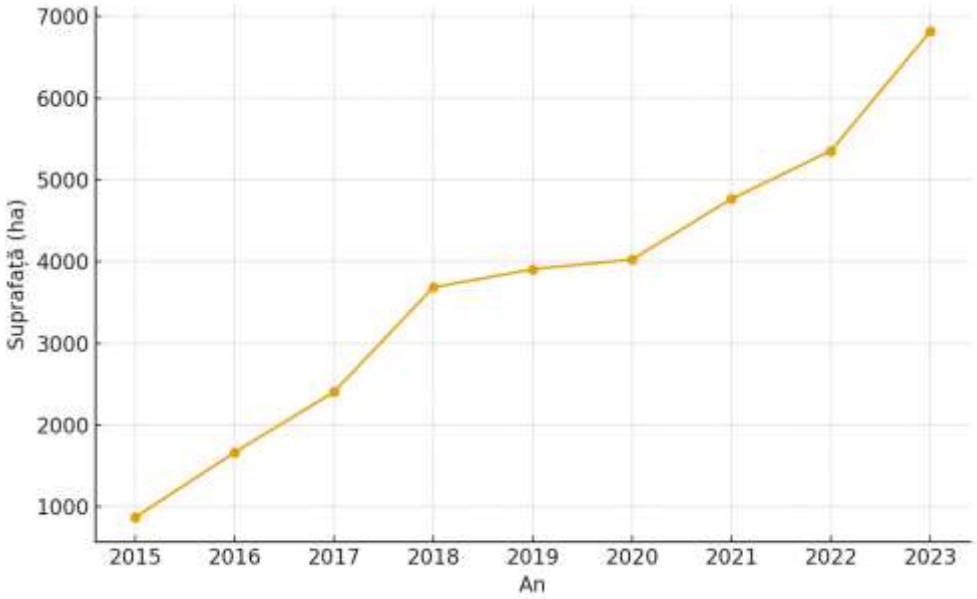

Fig. 3 Evolution of grassland areas under the A2 traditional mowing management category during the period 2015–2019

Overall, the evolution of the three agri-environmental management categories indicates a progressive increase in farmer participation in environmentally oriented grassland management systems. The positive trends observed across all categories suggest that agri-environmental payments contributed to the maintenance and improved management of permanent grasslands, supporting both agricultural sustainability and biodiversity conservation objectives within Hunedoara County

CONCLUSIONS

The present study evaluated the dynamics of permanent grasslands and the evolution of agri-environmental support categories in Hunedoara County during the analyzed period.

The results showed that permanent grasslands remained the dominant agricultural land-use category throughout the study period, emphasizing their continued importance within the agricultural landscape of the county. However, a gradual decline in grassland area was observed after 2019, while arable land exhibited a continuous increase, indicating ongoing changes in land-use patterns.

The analysis of agri-environmental support categories revealed positive trends for all investigated management systems. Grassland areas included in the A1 (grazing), A2 (traditional mowing), and A3

(mechanized mowing) categories increased over time, reflecting a growing participation of farmers in agri-environmental support schemes.

The expansion of grassland areas managed under agri-environmental commitments suggests an increasing adoption of management practices compatible with the objectives of the Common Agricultural Policy. Although the total area of permanent grasslands showed a moderate decline, the growth of areas enrolled in agri-environmental schemes indicates a greater involvement of farmers in support measures designed to encourage sustainable grassland management.

Overall, the results suggest that agri-environmental support schemes may play an important role in maintaining agricultural activity on permanent grasslands and supporting environmentally friendly management practices. Continued monitoring of grassland dynamics and farmer participation in support schemes is necessary to better understand the long-term effects of these measures on the conservation and sustainable use of permanent grasslands in Hunedoara County.

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