EXPLORING INNOVATIVE EUROPEAN SOLUTIONS FOR PASTURE UTILIZATION AND THEIR APPLICABILITY IN ENHANCING SUSTAINABLE AGRICULTURE PRACTICES IN ROMANIA

ISARIE VLAD*[1,2], GLIGA ADRIAN[1], CHICIUDEAN DANIEL[1], JITEA MUGUREL[1], ARION FELIX[1,2]

[1.] ***University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Department of Economic Sciences, Calea Mănăștur 3-5, 400372 Cluj-Napoca, România***

[2.] ***AgroTransilvania Cluster Str. Crişeni FN, Dezmir 407039, Cluj-Napoca, România***

*Corresponding author's e-mail: vlad-ilie.isarie@student.usamvcluj.ro

Abstract. *This study explores innovative European solutions for pasture utilization and evaluates their applicability in enhancing sustainable agriculture practices in Romania. Grazing, a traditional ruminant feeding method, is central to this investigation due to its benefits for ecosystems, animal health, and societal preferences [8, 19]. Challenges such as land fragmentation, rural depopulation, and the presence of large carnivores influence grazing practices across Europe, making it difficult for farmers to maintain traditional grazing methods and sustain livestock protection [13]. This paper advocates for agroecology as a holistic approach to sustainable agriculture, emphasizing the integration of animals into agroecosystems for ecological and socio-economic sustainability. By examining innovative grazing management practices from the most representative European countries, the study identifies best practices that can be adapted to Romanian conditions. Implementing these practices can address food security and climate change challenges, enhance product quality certification, and support the economic sustainability of Romanian agriculture.*

Keywords: *sustainable grazing innovation, farm efficiency, romanian pasture management, rural development in Romania, livestock management*

INTRODUCTION

In recent years, the agricultural sector has faced numerous challenges, including fluctuating market prices, increasing societal demands for sustainability, and environmental pressures such as climate change and biodiversity loss [11]. These challenges have significantly impacted grassland-based livestock systems, which are inherently complex and heavily influenced by local conditions [2]. To address these issues, there has been growing interest in innovative grazing management practices that integrate traditional knowledge with modern technologies. Grazing practices play a critical role in livestock farming, influencing productivity, sustainability, and the broader environmental and economic landscapes [17].

Traditional grazing methods, such as herding, have been practiced for generations, promoting biodiversity and sustainable land use [3]. However, the transition to innovative practices is essential for meeting contemporary challenges [14]. Agroecology offers a promising approach by integrating ecological principles into agricultural practices, encompassing the entire food chain from production to consumption [1]. Integrating practices such as organic farming and mixed grazing enhances biodiversity and animal welfare, underscoring the need for aligning farmer attitudes with these practices to foster a sustainable agricultural future [12].

A multitude of studies have demonstrated the beneficial effects of grazing on farmers' income, biodiversity conservation, carbon emission reduction, preservation of cultural landscapes, animal welfare enhancement, wildfire prevention, and food safety assurance [18]. The reasons behind the abandonment of grazing practices are diverse and influenced by local circumstances, including farm size, high stocking rates, land

fragmentation, concerns regarding feed supply and quality, as well as broader issues such as land abandonment and depopulation in rural European regions [10].

Traditional grazing methods, such as free-ranging, allow cattle to exhibit natural behaviors and forage in diverse landscapes, promoting physical and mental well-being and reducing stress-related behaviors. These methods also enhance cattle's ability to self-regulate their diet, leading to better overall health and productivity [15]. This article examines innovative and highly effective solutions for pasture utilization from various European countries and evaluates their potential application in Romania, especially in hilly and mountainous areas where overgrazing has led to soil degradation [7]. By analyzing these innovations, the study aims to provide insights into how modern technologies can be integrated with traditional practices to enhance the sustainability and efficiency of grazing systems in Romania.

The adoption of innovative grazing practices is both beneficial and challenging due to the complexity of grassland-based systems and the influence of local conditions [14]. Innovations in grassland management often involve trade-offs between various ecosystem services and may only become apparent over time. For European grassland farmers, pressures from unstable market prices, societal demands for sustainable practices, and environmental conservation necessitate innovative approaches that align with both ecological and economic sustainability [11].

Agroecology has emerged as a comprehensive approach to sustainable agriculture. Initially defined as a scientific discipline applying ecological principles to agroecosystem design and management, it now encompasses the entire food chain, from production to consumption [1]. Integrating animals into agroecosystems helps achieve long-term ecological sustainability and socio-economic viability in agriculture [5]. Traditional grazing methods, such as free-ranging and herding, allow cattle to exhibit natural behaviors and forage in diverse landscapes, promoting physical and mental well-being and reducing stress-related behaviors [15].

Modern innovations in grazing include electrified fencing, virtual fencing, and wildlife-friendly fencing, which enhance livestock management while maintaining ecological corridors [9]. Electrified fencing provides a flexible and less invasive alternative to traditional fencing, while virtual fencing uses GPS and wireless technologies to manage livestock movements, particularly useful in regions like Transylvania with traditional landscapes and semi-natural ecosystems. The integration of traditional knowledge with modern technologies can optimize grazing systems, improve animal welfare, and promote environmental sustainability [6].

Maintaining traditional practices, such as rotational grazing and transhumance, while adopting innovations like precision agriculture and remote sensing, can enhance the sustainability and efficiency of grazing systems [4]. Additionally, involving local communities and fostering knowledge-sharing among farmers can support the transition to more sustainable practices [16]. By understanding the economic, environmental, and ecological impacts of their production choices, farmers can make informed decisions that contribute to both short-term productivity and long-term sustainability [17]. The combination of traditional and innovative grazing practices offers a pathway to achieving a balance between agricultural productivity and environmental conservation, ensuring the resilience of grassland-based livestock systems in Europe and beyond [14].

MATERIAL AND METHOD

This study employs a multi-case study approach to analyze the applicability and impact of fourteen innovative practices from farms across seven European countries: Italy, Portugal, Netherlands, Ireland, France, Germany, and Sweden. From each country there

were analyzed two farms, providing a diverse range of innovative practices in grazing management. The fourteen innovations were selected from a total of over one hundred innovations based on their applicability in developing countries like Romania, considering criteria such as financial resources and skilled human resources required for their implementation. Data collection methods include self-assessment reports where each farm evaluates its performance based on agroecological principles, surveys to gather insights on farm performance and innovative ideas, and qualitative data from farmer narratives and practice videos documenting best practices. Additionally, knowledge-sharing sessions through farm walks and data from Agricultural Knowledge and Innovation Systems (AKIS) meetings provide further insights. This comprehensive approach ensures a robust understanding of the innovations' applicability and impact on grazing practices, facilitating the identification of best practices that can be adapted to Romanian conditions.

RESEARCH RESULTS

This section summarizes the outcomes of analyzing innovative grazing management practices from the case studies across seven European countries. The findings suggest that many of these innovations offer substantial potential for adaptation in Romania, especially considering the challenges faced by Romanian farmers.

Portugal - Harmonizing Agriculture and Livestock

The farm covers about 1,000 hectares, with over half of the land dedicated to the Montado system, and the rest includes olive groves and annual crops that integrate animals into the process. Recent innovations focus on optimizing profit crops, implementing cover crops, and integrating animals into the rotation cycle through holistic management. The farm also develops high-quality composting to address soil compaction and enhance soil health.

Implementation in Romania: In Romania, similar innovations can be initiated in large farms over 100 hectares to implement agro-silvopastoral systems. Training and educational courses could be very useful for farmers on using cover crops and holistic management. Collaborating with agricultural research institutions to develop and apply composting methods is also essential.

Portugal - Vegetable and Animal Production Optimization

The farm covers 900 hectares, with 600 hectares dedicated to rice production and significant areas for vegetables and grassland for cattle. Grasslands are efficiently managed, allowing cattle to graze in specific areas for about 3 days. This strategy enhances animal welfare and promotes sustainable farming. The farm uses seed mixtures to optimize production, increase yields, and reduce costs, and excels in cattle reproduction by shortening the calving interval.

Implementation in Romania: To apply these practices in Romania, workshops on efficient grassland management techniques should be conducted. Promoting the use of seed mixtures will help optimize production and reduce costs. Programs to shorten calving intervals and improve cattle productivity could also be implemented.

France - Quad Seeding

Quad seeding of meadows offers benefits such as fast seeding (20 minutes per hectare), reduced soil compaction, and lower fuel consumption. The process involves seeding 3.5 meters apart in rows and then diagonally to ensure good coverage. Additionally, agroforestry is practiced by planting tree species in paddocks to protect animals from the sun and wind.

Implementation in Romania: In Romania, subsidies or EU funds could be obtained for the purchase of agricultural equipment and quads. Promoting agroforestry practices by encouraging the planting of tree species in paddocks will also be beneficial. Farm visits could help the Farmers to easily identify plenty of innovations and good practices.

France - Cow-Friendly Infrastructure

A farm with 100 Normande dairy cows on 85 hectares produces 550,000 liters of milk annually. Innovations include the creation of 1.5 km of tracks and a cow tunnel to expand grazing areas; it reduced the feeding costs and the workload. These improvements have significantly decreased operational costs and improved pasture management.

Implementing in Romania Romanian farmers can benefit from visiting French farms and exchanging experiences with French farmers. By observing these practices, they can learn how to adopt similar innovations. Additionally, Romanian farmers can evaluate these improvements from an economic perspective, weighing the costs against the potential revenue.

Italy - Steep Slope Grazing

At the P. family's farm in South Tyrol, cows graze on slopes with an average incline of 50%. The compartmented short sward grazing system promotes effective grazing management and continuous grass regeneration. Tyrolean Grey cattle, well adapted to alpine conditions, are used. Grazing on steep slopes offers significant benefits, including high-quality feed and cost savings on concentrated feed.

Implementation in Romania: This innovation demonstrates that the natural landscape, even with steep inclines, should not be a barrier to grazing or starting a farm. Instead, it presents a challenge to adapt cattle breeds to the specific conditions of each type of terrain and to make the farm as productive as possible. Romanian farmers can take inspiration from this practice to optimize their use of hilly or mountainous land.

Italy - Site-Adapted Livestock Farming with Goats

The goat farm houses 50 dairy goats that graze on steep slopes. In spring, pastures near the farm buildings are managed as short sward grazing systems, and in summer, goats are moved to alpine pastures. This reduces summer workload and maintains animal health by minimizing parasite pressure. Deworming is based on fecal sample tests, reducing the need for anthelmintics.

Implementation in Romania: Site-adapted livestock farming with goats should be promoted in Romania, particularly on steep slopes. Currently, there are not many dedicated goat farms in the country, and the potential for utilizing mountain pastures is largely untapped. By adopting practices such as rotating goats between lowland pastures in the spring and alpine pastures in the summer, Romanian farmers can reduce their workload and improve animal health. Additionally, implementing fecal sample tests for targeted deworming can help maintain the health of the goats and reduce reliance on chemical treatments

Sweden - Predator-Deterrent Fences

Farm B. focuses on lamb production with 300 ewes on 90 hectares of arable land and 60 hectares of semi-natural grasslands. Predator-deterrent fences with electric wires have successfully reduced attacks from wolves and lynx. The county administrative board offers agri-environmental payments covering 50% of the costs.

Implementation in Romania: While electric fencing is no longer considered innovative, the real advancement lies in the strategic installation based on precise measurements of wildlife behavior. Farmers need to understand how high wildlife can jump and how low they can squeeze through. In Romania, there are already many funding options available for these types of fences. By adopting this approach, Romanian farmers can effectively protect their livestock from predators while utilizing available resources and funding.

Sweden - Map and Excel Spreadsheet for Rotational Grazing

T. runs a farm with 1,000 ewes on 200 hectares of arable land and 150 hectares of semi-natural grasslands. Grass growth in paddocks is controlled and monitored using maps and Excel spreadsheets. Grazing is documented, and paddocks are prioritized based on regrowth. Digital solutions for production monitoring and planning are also planned.

Implementation in Romania: Farmers in Romania should be trained in using detailed grazing management systems and prioritizing paddocks based on regrowth. Implementing digital solutions for monitoring and planning will enhance productivity. There is no need for expensive innovations or applications; a simple Excel sheet where farmers can insert and analyze data is sufficient. Additionally, drawing a map of grazing plots, as done by the Swedish farmer, can provide a better view of pasture management, facilitating effective rotational grazing. This approach will help optimize the use of available land and improve overall farm efficiency.

Ireland - Day and Night Grazing

L. has a farm of 134 hectares. To limit walking distance for cows, they graze near the milking parlor at night and on distant paddocks during the day. This strategy improves grass utilization and decreases feed costs. Grazing infrastructure and management are also improved, including building underpasses to avoid road crossings.

Implementation in Romania: This innovation is particularly beneficial for fragmented farms. By keeping cows as close as possible to the milking parlor at night, farmers can increase milk production. Improving grazing infrastructure, such as building underpasses, can help reduce workload and accidents. Romanian farmers can adopt this strategy to optimize grazing efficiency and improve overall farm productivity.

Ireland - Having Students on the Farm

J. and his wife host students on their farm, where they participate in daily farm tasks and have access to YouTube videos and guideline sheets. Emphasizing mutual trust and open communication, this approach eventually reduces J.'s workload and fosters knowledge exchange.

Implementation in Romania: Collaborations with universities and agricultural high schools should be established to offer students practical internships on farms, enhancing their learning and reducing farmers' workloads. To improve organization, farms can provide schedules in advance and propose activities along with the time needed to complete each task. This way, students can choose activities and time periods that suit them, making the experience more flexible and efficient. This approach will not only enhance students' practical skills but also support farmers in managing their daily tasks more effectively.

Netherlands - Efficient Cow Fetching Using Border Collie Herding Techniques

R. runs a dairy farm with 130 cows and uses a specially trained Border Collie to fetch cows. This minimizes labor and simplifies the process, with the dog herding the cows calmly towards the barn, requiring minimal intervention from R.

Implementation in Romania: While this innovation is already common in pastoral and sheep farms in Romania, it could also be highly beneficial for dairy farms. The primary cost is associated with training the dog, but this investment can significantly improve efficiency and reduce labor. By introducing trained herding dogs on cow farms, Romanian farmers can streamline the process of moving cattle, making daily operations more manageable and productive.

Netherlands - Jerseys as Pasture Cows

J. manages 100 dairy cows on 30 hectares and purchased a herd of Jersey cows, which use less feed and learn to graze quickly. Jerseys produce high-quality products with less feed, fitting well into the landscape and improving stocking rates.

Implementation in Romania: Choosing a breed based on the available conditions on the farm can be a very wise decision. Jersey cows are not only known for their beauty but also for their efficiency. Being a bit thinner, they require less feed. Although their milk production may not be as high as other breeds, their milk is richer in fat and known for its higher quality. Adopting Jersey cows in Romania could help farmers reduce feed costs while producing premium dairy products, enhancing both economic and product quality aspects of their operations.

Germany - Shifting to Grass-Fed Premium Beef

J. G. manages 105 hectares of grassland with about 50 beef cattle. The farm transitioned from dairy to a suckler cow system, maintaining added value through direct marketing. Angus cattle, suitable for 100% grass-fed production, are used. They established a farm shop to sell beef products directly and plan to strengthen ties with catering services.

Implementation in Romania: Encouraging Romanian farms to diversify into grass-fed beef production and direct marketing will increase profitability. Implementing the "farm to fork" principle can boost client engagement and satisfaction. This innovation is already present in some larger farms in Romania, where clients have the opportunity to see the animals on pasture, observe the meat processing, and taste the final product. There is still plenty of room for more farms to adopt these practices, enhancing their offerings and creating a unique farm-to-table experience for customers.

Germany - Matching Forage Quality with Nutritional Requirements

W. and K. run a pasture-based dairy farm with 130 dairy cows and 170 young stock. Frequent forage value analyses match the nutritional requirements of their animals with grass quality. High-nutritional forage from saltwater-flooded pastures is used for dry cows. Urea levels are analyzed every second day to adjust feeding patterns. This strategy has reduced veterinary costs and ensured consistent productivity.

Implementation in Romania: Although this innovation may seem more suitable for large-scale farms, small farmers in Romania can also benefit from it through training and knowledge exchange. Learning simple hacks or practices, such as regular forage analysis and adjusting feeding patterns based on urea levels, can significantly increase productivity and reduce veterinary costs. By adopting these strategies, small-scale farmers can improve their herd health and overall farm efficiency.

Suggestions for Future Studies. The issue of labor shortages in agriculture in Romania requires a swift and effective approach. The implementation of technological innovations is essential for transforming Romanian farms from Subsistence to Profitability and to sustainable and efficient entities. In the long term, it is necessary to invest in the training and education of farmers to familiarize them with new technologies and agricultural practices.

Additionally, the government and responsible organizations should provide financial and technical support for the adoption of these innovations, thereby ensuring the future of Romanian agriculture.

By providing a steady flow of information, facilitating knowledge exchange, and connecting farmers with resources and opportunities, the Grazing 4 AgroEcology network would empower Romanian farmers to transform their operations into sustainable and efficient entities. This, in turn, would help mitigate the impact of labor shortages and ensure the long-term viability of the agricultural sector in Romania.

Knowledge Dissemination and Awareness

An EU newsletter network serves as a platform for disseminating information about the latest technological advancements and innovative practices in agriculture. By regularly providing updates, case studies, and success stories from across Europe, the newsletter increases awareness among Romanian farmers about the available solutions that can mitigate labor shortages and improve efficiency. Additionally, the network facilitates collaboration and networking among farmers, researchers, and agricultural professionals from eight EU project member countries (France, Germany, Ireland, Italy, the Netherlands, Portugal, Romania, and Sweden). By fostering a sense of community and encouraging the exchange of ideas, the network promotes collaborative efforts to solve common challenges, including labor shortages.

Technological Innovations

Drone usage, Direct Sale, Agortourism, Virtual Fencing, Agroforestry, Rotational Grazing and many other subjects, would keep farmers informed about the latest developments. Demonstrating the tangible benefits and potential return on investment of these innovations would encourage more farmers to adopt them, reducing their reliance on manual labor.

CONCLUSIONS

Implementing these innovative practices in Romania requires tailored approaches for each region and farm type, considering available resources and farmers' ability to adopt new technologies. Pilot projects, proper training, and financial support are decisive for success.

Encouraging knowledge exchange and collaboration with agricultural research institutions will help adapt best practices to local conditions. Combining traditional methods with modern technologies can enhance the sustainability and efficiency of Romanian grazing systems.

Analyzing Romania's potential, it is clear that establishing quality certification for products derived from pasture could significantly boost consumer awareness of the benefits of grazing. This certification would help producers market their products more effectively, increasing their marketability and profitability.

The case studies show that strategic investments in grazing infrastructure and management can reduce costs, improve pasture management, and support the certification of high-quality products. These insights provide valuable lessons for Romanian farmers aiming to improve productivity and sustainability.

Adopting these practices offers an opportunity to address food security and climate change challenges while supporting the economic sustainability of Romanian agriculture. With the right support, these innovations can help transform Romania's agricultural landscape for a resilient future.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to the Grazing4AgroEcology team for their invaluable contributions to this research project. We also extend our thanks to the AgroTransilvania Cluster and the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca for their support and assistance throughout the course of this study.

REFERENCES

[1]. ALTIERI M., 1987, Agroecology: The Scientific Basis of Alternative Agriculture, Westview Press.
[2]. BUMBA C., 2019, Maximizing Natural Resource Productivity in Food Production, Journal of Sustainable Agriculture, 13(2), 45-56.
[3]. CIOCAN-ALUPII MARIA, MACIUC V., 2020, Considerations regarding the mountainous area of Romania: Present and perspectives in relation to the breeding activity of cattle, Scientific Papers. Series D. Animal Science, Vol. LXIII, No. 1, pp. 301-305.
[4]. DUMONT B., GONZÁLEZ-GARCÍA ESTHER, THOMAS M., FORTUN-LAMOTHE LAURE, DUCROT C., DOURMAD J-Y., TICHIT M., 2014, Forty research issues for the redesign of animal production systems in the 21st century, Animal, Vol. 8, Issue 8, pp. 1382-1393
[5]. GLIESSMAN S. R., 2015, Agroecology: The Ecology of Sustainable Food Systems, CRC Press.
[6]. HOLZEIS CLAUDIA, FEARS R., MOUGHAN P. J., BENTON T. G., HENDRIKS S. L., CLEGG M., VON BRAUN J., TER MEULEN V., 2019, Economic Efficiency and Sustainable Resource Use in Global Food Systems, International Journal of Agricultural Sustainability, 17(3), 298-312.
[7]. IAGARU POMPILICA, IAGARU R., CIORTEA G., FLORESCU N., CIUBOTARU G., 2015, Sustainable development management of the grassland agroecosystem in the context of biodiversity conservation and improvement of permanent grassland, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 15, Issue 1, pp. 225
[8]. JACKSON AMY, GREEN M., MILLAR KATE, KALER JASMEET, 2020, Is it Just About Grazing? UK Citizens Have Diverse Preferences for How Dairy Cows Should Be Managed, Journal of Dairy Science, 103(4), 3250-3263.
[9]. JAKES A.F., et al., 2018, Wildlife-Friendly Fencing: Harmonizing Conservation and Livestock Management, Wildlife Society Bulletin, 42(1), 50-58.
[10]. JRC POLICY INSIGHTS, 2018, Agricultural Land Abandonment in the EU within 2015-2030, European Commission.
[10]. KRAUSE ARNO, BECKER T., 2019, Challenges and Opportunities for Sustainable Grassland Management in Europe, Grassland Science in Europe, 24, 12-18.
[12]. MARKIEWICZ-KĘSZYCKA MARIA, CARTER AILEEN, O'BRIEN D., HENCHION M., MOONEY S., HYNDS P., 2023, Pro-Environmental Diversification of Pasture-Based Dairy and Beef Production in Ireland, the United Kingdom and New Zealand: A Scoping Review of Impacts and Challenges, Renewable Agriculture and Food Systems, 38, e5.
[13]. MEURET M., MOULIN C-H, BONNET O., GARDE L., NOZIERES-PETIT MARIE-ODILE, LESCUREUX N., 2020, Missing Shots: Has the Possibility of Shooting Wolves Been Lacking for 20 Years in France's Livestock Protection Measures?, Rangeland Journal, 42(6)

[14]. ROUET-LEDUC JULIA, VAN DER PLAS F., BONN ALETTA, PE'ER G., 2024, Exploring the Motivation and Challenges for Land-Users Engaged in Sustainable Grazing in Europe, Land Use Policy, 141(1)

[15]. SCOTTON M., CRESTANI D., 2019, Traditional Grazing Systems in the Venetian Alps: Effects of Grazing Methods and Environmental Factors on Cattle Behaviour, Journal of Environmental Management, 250

[16]. SUTHERLAND W. J., **ALBON S. D.**, **ALLISON HILARY**, **ARMSTRONG-BROWN S.**, **BAILEY M. J.**, **BRERETON T.**, **BOYD I. L.**, **CAREY P.**, **EDWARDS, J.**, **GILL MAGGIE**, **HILL D.**, **HODGE I.**, **HUNT A. J.**, **LE QUESNE W. J. F.**, **MACDONALD D. W.**, **MEE L. D.**, **MITCHELL R.**, **NORMAN T.**, **OWEN R. P.**, **PARKER D.**, **PRIOR STEPHANIE V.**, **PULLIN AN. S.**, **RANDS M. R. W.**, **REDPATH S.**, **SPENCER J.**, **SPRAY C. J.**, **THOMAS C. D.**, **TUCKER G. M.**, **WATKINSON A. R.**, **CLEMENTS A.**, 2010, The Identification of Priority Policy Options for UK Nature Conservation, Journal of Applied Ecology, 47(5), 955-965.

[17]. TEAGUE R., KREUTER URS, 2020, The Role of Grazing Management in Restoring Soil Health and Ecosystem Function, Soil and Water Conservation Journal, 75(3), 74-88. DOI: 10.3389/fsufs.2020.534187. License: CC BY 4.0.

[18]. VAN DEN POL-VAN DASSELAAR AGNES, HENNESSY DEIRDRE, ISSELSTEIN J., 2020, Grazing of Dairy Cows in Europe—An In-Depth Analysis Based on the Perception of Grassland Experts, Sustainability, 12(3), 1098

[19]. XIONG D., **SHI PEILI**, **ZHANG XIANZHOU**, **ZOU C. B.**, 2016, Effects of Grazing Exclusion on Carbon Sequestration and Plant Diversity in Grasslands of China—A Meta-Analysis, Ecological Engineering, 94, 647-655