AN ANALYTICAL ANALYSIS OF BIODIVERSITY IN AGRICULTURAL SYSTEMS

Adela Sorinela SAFTA, Bucharest University TITU MAIORESCU, Institute of Studies, Research, Development and Innovation, Bucharest, Romania, ORCID ID (https://orcid.org/0000-0002-5435-4707), saftaadela19@stud.ase.ro
Lavinia POPESCU, BucharestUniversity of Economic Studies, Doctoral of economic school, Bucharest, Romania, popesculavinia14@stud.ase.ro, ORCID ID (https://orcid.org/0000-0003-2545-7739) adela.safta@unibuc.ro

Abstract: This paper examines the evolution of agriculture from a biodiversity conservation perspective, focusing on the interactions between farming practices, ecosystem health, and environmental policy frameworks. It highlights how agricultural intensification, monoculture systems, and the excessive use of fertilizers and pesticides contribute to habitat fragmentation, soil degradation, and the decline of pollinators and other key species essential for ecosystem functioning. Sustainable agriculture is increasingly recognized as a key instrument not only for mitigating climate change but also for protecting and restoring biodiversity. In this context, the reform of the Common Agricultural Policy (CAP) places growing emphasis on environmental objectives, including the conservation of ecosystems and the reduction of pressures on natural habitats. However, achieving a balance between agricultural productivity and biodiversity protection remains a central challenge, particularly in systems characterized by intensive production and high input use.

Keywords: *income inequality, Lorenz curve, economic inequality, policy analysis.*

1. INTRODUCTION

Scientific evidence shows that biodiversity loss in agricultural landscapes is driven by multiple interconnected factors, including land-use change, deforestation, water ecosystem degradation, and the simplification of production systems. The reduction in species diversity and genetic resources weakens ecosystem resilience and reduces the capacity of agricultural systems to provide essential ecosystem services such as pollination, soil fertility, and water regulation.

At the same time, the paper emphasizes the potential of environmentally friendly agricultural practices to reverse these trends. Approaches such as agroecology, organic farming, agroforestry, and landscape diversification are increasingly recognized as effective tools for enhancing biodiversity while maintaining productive capacity. Policy instruments at the European level, including targeted subsidies and ecological schemes, play a crucial role in incentivizing farmers to adopt biodiversity-friendly practices.

Overall, the study underscores the importance of integrating biodiversity conservation into agricultural policy and practice, highlighting the need for a systemic transition toward farming systems that support both food production and ecological sustainability.

The transformation of natural habitats into farmland, combined with the increased use of chemical inputs and the simplification of production systems, has significantly altered ecosystem structure and function.

In Europe, agricultural landscapes have historically contributed to biodiversity through traditional low-intensity farming systems. However, the modernization and intensification of agriculture over recent decades have led to a decline in species richness, habitat heterogeneity, and ecosystem resilience. Monocultures, heavy reliance on fertilizers and pesticides, and the removal of semi-natural habitats such as hedgerows and wetlands have contributed to the degradation of ecological networks that support pollinators, birds, soil organisms, and other key species.

These trends have raised increasing concerns within environmental policy frameworks, particularly at the level of the European Union. The Common Agricultural Policy (CAP) has progressively incorporated environmental and biodiversity objectives, reflecting a shift from purely production-oriented support to a more integrated approach that recognizes the ecological functions of agricultural landscapes. This policy evolution reflects the growing understanding that biodiversity is not separate from agriculture, but rather a fundamental component of its long-term sustainability.

At the same time, scientific research has increasingly highlighted the interconnectedness between biodiversity loss, climate change, and ecosystem degradation. The reduction of biological diversity weakens ecosystem stability and reduces the capacity of natural systems to provide essential services such as pollination, soil fertility, water purification, and pest regulation. These services are critical not only for environmental health but also for maintaining agricultural productivity itself.

In response to these challenges, there has been a growing interest in agricultural models that integrate biodiversity conservation into production systems. Approaches such as agroecology, organic farming, agroforestry, and diversified cropping systems are being explored as alternatives to conventional intensive agriculture. These practices aim to restore ecological balance while maintaining economic viability for farmers.

Against this background, the present study explores the relationship between agricultural development and biodiversity conservation, with a focus on how policy instruments, technological innovations, and farming practices can contribute to more sustainable and resilient agro-ecosystems.

2. LITERATURE REVIEW

The relationship between agriculture and biodiversity has been extensively addressed in environmental science and ecological economics literature, particularly in the context of accelerating habitat loss and ecosystem degradation. A large body of research identifies agricultural intensification as a key driver of global biodiversity decline, primarily through land-use change, habitat fragmentation, and the simplification of agroecosystems (Foley et al., 2005; IPBES, 2019).

Early studies emphasized the ecological consequences of modern industrial agriculture, particularly the replacement of diverse landscapes with monocultures and the increased reliance on synthetic inputs such as fertilizers and pesticides. These practices have been strongly associated with declines in pollinators, farmland birds, soil biota, and plant diversity (Tilman et al., 2001; Geiger et al., 2010). Such losses negatively affect ecosystem functioning, including pollination services, nutrient cycling, and natural pest control.

More recent research has shifted toward identifying agricultural systems capable of reconciling production with biodiversity conservation. Agroecology is widely recognized as a framework that integrates ecological principles into agricultural design and management. Studies indicate that diversified cropping systems, reduced chemical inputs, and habitat heterogeneity at the landscape level can significantly enhance biodiversity while maintaining yields (Altieri, 1999; Kremen & Miles, 2012). Organic farming systems are also frequently associated with higher species richness and improved ecological quality compared to conventional systems (Bengtsson, Ahnström & Weibull, 2005).

Agroforestry systems have been highlighted in the literature as particularly effective in supporting biodiversity conservation. By integrating trees with crops and/or livestock, these systems enhance habitat complexity, increase species diversity, and improve ecological connectivity across landscapes (Jose, 2009). Similarly, conservation agriculture practices such as reduced tillage and cover cropping contribute to soil biodiversity and improve ecosystem resilience (Hobbs, Sayre & Gupta, 2008).

At the policy level, the European Union's Common Agricultural Policy (CAP) has been widely analyzed for its role in shaping biodiversity outcomes. While earlier policy instruments were primarily production-oriented, recent reforms increasingly incorporate environmental conditionality and biodiversity-focused measures. Agri-environment-climate schemes (AECS) and ecological focus areas are identified as important tools for incentivizing biodiversity-friendly farming practices, although their effectiveness depends on design, funding levels, and implementation at national level (Pe'er et al., 2014; EC, 2021).

Furthermore, landscape-scale approaches are increasingly emphasized in the literature. Rather than focusing exclusively on individual farms, researchers argue that biodiversity conservation requires coordinated management across agricultural landscapes to maintain habitat connectivity and ecological networks (Tscharntke et al., 2005). This approach highlights the importance of spatial planning and collective action in achieving biodiversity goals.

Overall, the literature suggests a gradual paradigm shift from viewing agriculture and biodiversity as conflicting objectives toward recognizing their potential compatibility under sustainable management systems. However, challenges remain regarding economic incentives, policy coherence, and the large-scale adoption of biodiversity-friendly practices.

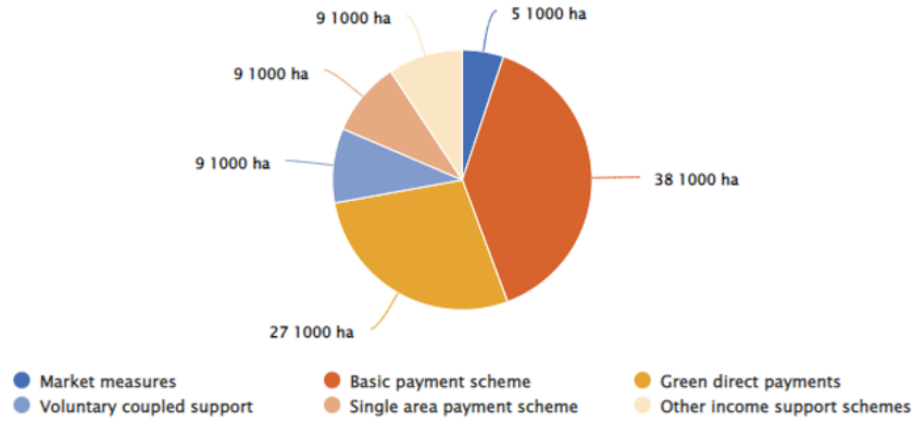

Figure 1. European Agricultural Guarantee Fund expenditure on income support and market measures - *Source Eurostat data 2024*

The Figure 1 illustrating the agricultural sector can be interpreted as a systemic representation of how agricultural production interacts with economic, environmental, and policy dimensions. It typically visualizes the sector as a multi-layered system in which inputs, production processes, and outputs are interconnected with environmental and institutional feedback loops. At the core of the agricultural sector is the production system, where land, labor, capital, and technology are combined to generate food and raw materials. The figure usually shows how these inputs are influenced by technological advancement, particularly through innovations such as mechanization, digital farming tools, and precision agriculture systems. These technologies act as efficiency enhancers, enabling higher productivity while reducing input waste and environmental pressure.

Surrounding the production core, the figure often highlights environmental components such as soil quality, water resources, biodiversity, and atmospheric emissions. These elements are both influenced by and influential upon agricultural activities, creating a dynamic feedback relationship. Intensive agricultural practices may degrade environmental quality, while sustainable practices contribute to ecosystem restoration and long-term resilience.

Another important dimension depicted in the figure is the role of policy and institutional frameworks. These include regulatory measures, environmental standards, subsidies, and market-based instruments such as payments for ecosystem services and carbon pricing mechanisms. These policy tools act as external drivers that shape farmer behavior and encourage the adoption of sustainable practices. Their presence in the system highlights that agricultural outcomes are not determined solely by market forces but are significantly influenced by governance structures.

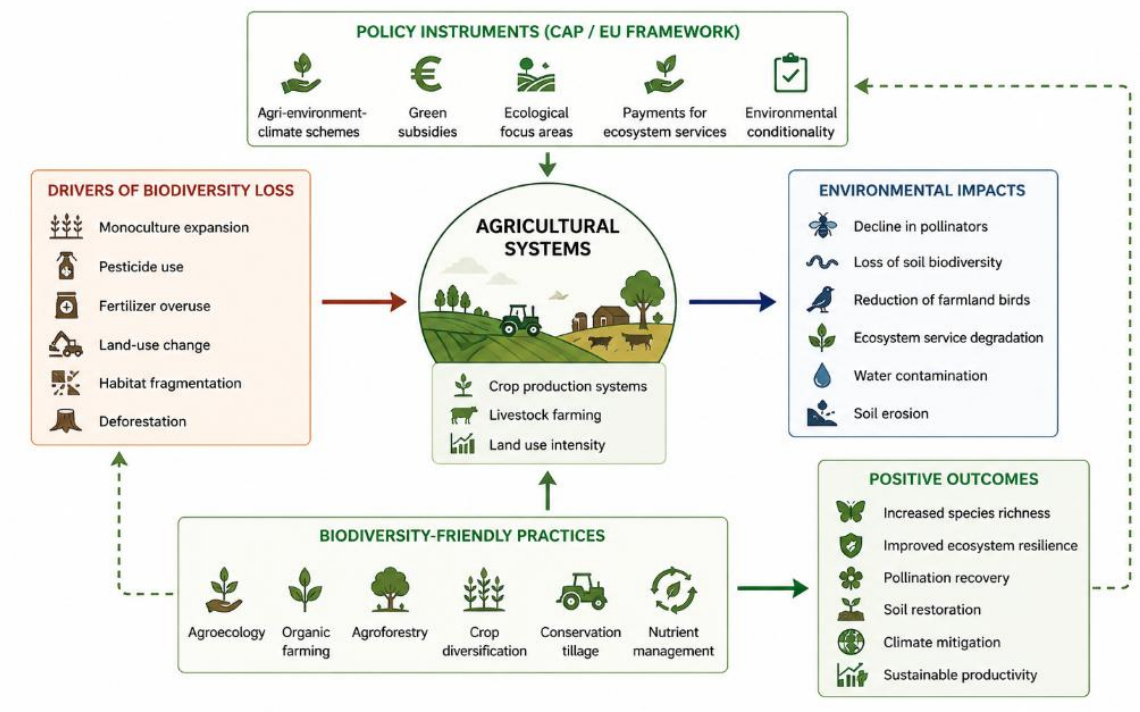

Figure 2. Conceptual framework linking agricultural systems, driving of biodiversity loss - Source Our recherche

The figure also typically incorporates supply chain and market linkages, showing how agricultural outputs move from production units to processing, distribution, and final consumption. These linkages emphasize the integration of agriculture into broader economic systems and highlight how consumer demand, trade dynamics, and global markets influence production decisions.Overall, the figure of the agricultural sector presents a holistic view of agriculture as an interconnected system where economic activity, environmental sustainability, and policy intervention interact continuously. It reinforces the idea that sustainable agricultural development requires coordinated action across multiple levels, including farm management, institutional regulation, and market organization.

3. CONCLUSIONS

The analysis of the relationship between agriculture and biodiversity highlights the critical need to reconcile food production objectives with environmental conservation goals. Agricultural intensification has contributed significantly to biodiversity loss through habitat destruction, monoculture expansion, and increased use of chemical inputs, all of which have weakened ecosystem functions and reduced species richness across agricultural landscapes.

However, the findings also demonstrate that agriculture can play a positive role in biodiversity conservation when supported by appropriate practices and policy frameworks. Approaches such as agroecology, organic farming, agroforestry, and conservation-oriented land management show strong potential to restore ecological balance while maintaining productive capacity. These practices contribute to improved soil health, enhanced habitat connectivity, and the recovery of key ecosystem services such as pollination and nutrient cycling. Policy instruments, particularly within the European Union's Common Agricultural Policy, are essential in facilitating this transition. Through financial incentives, regulatory measures, and environmental schemes, policymakers can encourage farmers to adopt biodiversity-friendly practices and reduce environmentally harmful activities. Nevertheless, the effectiveness of these instruments depends on consistent implementation, adequate funding, and alignment with local agricultural conditions. Overall, achieving biodiversity conservation in agricultural systems requires a holistic and integrated approach that combines technological innovation, sustainable farming practices, and strong policy support. The transition toward more sustainable agriculture is not only an environmental necessity but also a strategic pathway for ensuring long-term agricultural resilience and ecosystem stability.

4. REFERENCES

[24] **Altieri, M. A**. (1999). *The ecological role of biodiversity in agroecosystems*. Agriculture, Ecosystems & Environment, 74(1–3), 19–31.

[25] **Bengtsson, J., Ahnström, J., & Weibull, A. C.** (2005). *The effects of organic agriculture on biodiversity and abundance: A meta-analysis.* Journal of Applied Ecology, 42(2), 261–269. https://doi.org/10.1111/j.1365-2664.2005.01005.x

[26] European Commission. (2021). Common Agricultural Policy strategic plans. https://agriculture.ec.europa.eu

[27] **Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N., & Snyder, P. K.** (2005*). Global consequences of land use*. Science, 309(5734), 570–574. https://doi.org/10.1126/science.1111772

[28] **Geiger, F., Bengtsson, J., Berendse, F., et al.** (2010). Persistent negative effects of *pesticides on biodiversity and biological control potential on European farmland.* Basic and Applied Ecology, 11(2), 97–105. https://doi.org/10.1016/j.baae.2009.12.001

[29] **Hobbs, P. R., Sayre, K., & Gupta, R.** (2008). *The role of conservation agriculture in sustainable agriculture.* Philosophical Transactions of the Royal Society B, 363(1491), 543–555. https://doi.org/10.1098/rstb.2007.2169

[30] IPBES. (2019). *Global assessment report on biodiversity and ecosystem services*. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. https://ipbes.net

[31] **Jose, S.** (2009). *Agroforestry for ecosystem services and environmental benefits: An overview.* Agroforestry Systems, 76, 1–10. https://doi.org/10.1007/s10457-009-9229-7

[32] **Nancu et al** (2022) *A strategies for using nitrates to improve soil performance and soil c sequestration*, Economics of Agriculture, January 2022, Ekonomika Poljopridere 69(3):649-664, DOI: 10.5937/ekoPolj2203649P, https://ea.bg.ac.rs/index.php/EA/article/view/1976

[33] OECD reports 8-June-2021, Building Agricultural Resilience to Natural Hazard-induced Disasters - Insights from Country Case Studies https://www.oecd.org/unitedstates/publicationsdocuments/reports/

[34] **Popescu L**., et al. (2020) - *The impact of agricultural activities on greenhouse gas generation*, published in the Journal of Research and Innovation for a Sustainable Society (JRISS) Volume 2, Issue 1, 2020 ISSN: 2668-0416 Thoth Publishing House, DOI: 10.33727/JRISS.2020.1.13:87-102, https://jriss.4ader.ro/pdf/2020-01/13_Safta.pdf.

[35] **Popescu, L., & Safta, A. S.** (2020, July). *Considerations regarding improving the ecological and environmental performance of agriculture.* In *Proceedings of the International Conference on Business Excellence* (Vol. 14, No. 1, pp. 697-707). Bucharest University of Economic Studies.

[36] **Popescu, L**., at al, 2021, *The role of phosphates in agriculture and highlighting key issues in agriculture from a climate change perspective*, Economics of Agriculture, Published: 2021-12-24, Vol. 4 (2021), 1001-1014; htps://ea.bg.ac.rs/index.php/EA/index

[37] **Pugh, TAM, Arneth, A., Olin, S., Ahlström, A., Bayer, AD, Goldewijk, KK, ... & Schurgers, G.** (2015). *Simulated carbon emissions from land-use change are substantially enhanced by accounting for agricultural management*. Environmental Research Letters, 10(12), 124008.

[38] Regulation (EC) No 1185/2009 of the European Parliament and of the Council of 25 November 2009 concerning statistics on pesticides (Text with EEA relevance), OJ L 324, 10.12.2009, pp. 1–22;

[39] **Safta, A. S., & Popescu, L.** (2024). *Considerations regarding environmental performance from the perspective of the sustainability*. Environmental Engineering & Management Journal (EEMJ), 23(3).

[40] **Popescu, L., & Safta, A. S.** (2020). *The causal relationship of agricultural standards, climate change and greenhouse gas recovery.* Environmental Sciences Proceedings, 4(1), 21.

[41] **Popescu, L., & Safta, A. S.** (2021). *The role of phosphates in agriculture and highlighting key issues in agriculture from a climate change perspective*. Економика пољопривреде, 68(4), 1001-1014.

[42] **Safta, A. S., & Popescu, L.** (2024). *Sustanaibility from concept to paradigm of environmental policies.* Eastern European Journal for Regional Studies (EEJRS), 181-193. DOI: https://doi.org/10.53486/2537-6179.10-1.11

[43] **Tilman, D., Fargione, J., Wolff, B., D'Antonio, C., Dobson, A., Howarth, R., Schindler, D., Schlesinger, W. H., Simberloff, D., & Swackhamer, D.** (2001). *Forecasting agriculturally driven global environmental change*. Science, 292(5515), 281–284. https://doi.org/10.1126/science.1057544

[44] **Tscharntke, T., Klein, A. M., Kruess, A., Steffan-Dewenter, I., & Thies, C. (2005).** *Landscape perspectives on agricultural intensification and biodiversity.* Ecology Letters, 8(8), 857–874. https://doi.org/10.1111/j.1461-0248.2005.00782.x