DOI: 10.2478/AGR-2023-0006

THE ANNALS OF "VALAHIA" UNIVERSITY OF TARGOVISTE

ANALYSIS OF ECOLOGICAL AGRICULTURE FROM THE PERSPECTIVE OF MAINTAINING THE BIODIVERSITY OF AGRICULTURAL LANDS

Mariana Sandu[1], Amalia Gianina Strateanu[1], Lavinia Udrea[2]
[1]Romanian Academy, Center for Studies and Researchers of Agroforestry Biodiversity, Calea 13 Septembrie, no. 13, 5th district, Bucharest, Romania
[2]Valahia University of Targoviste, 13, Sinaia Alley, Targoviste, Romania
E-mail: marianasandu47@gmail.com, strateanuamalia.research@gmail.com, moise_l74@yahoo.com

Abstract

The intensification of agriculture, the specialization of production and the use of a wide range of agrochemicals has led to the loss of biodiversity on agricultural land, namely the cultivation of a small number of high-yielding varieties and short crop rotation. The loss of biodiversity and the homogenization of crops directly affects the productivity of agroecosystems and implicitly the sustainability of food systems.

In this context, the article proposes an analysis of the evolution of ecological agriculture from the perspective of the need for a change in the structure and operation of agriculture to restore the biodiversity of agricultural land. The analysis is oriented towards the economic, social and environmental aspects given the fact that, often, ecological agriculture is proposed as a solution to ensure the food security of the world's population.

The analysis of data on global organic agriculture indicates that, in 2021, the total area of agricultural land cultivated in the organic system represented approximately 1.6% of the total agricultural land, the number of producers registered in organic agriculture reached approximately 3.7 million and the global market for organic products reached 125 billion euros.

With regard to organic agriculture in Romania, in 2021, the total area cultivated in an ecological system was 578.7 thousand ha (3.2% of agricultural land cultivated organically in the EU), and the number of economic operators was 12,231.

Given that the productions obtained in the ecological system are 20-40% lower than those in conventional agriculture, the integration of ecological practices in agriculture has the potential to increase the productions obtained and maintain biodiversity on agricultural land.

Keywords: biodiversity, ecological agriculture, producers, ecological products, environment

1. INTRODUCTION

Global food security faces a number of challenges from population growth, rising consumption, climate change pressures and competition from biofuels. Ensuring food security is closely related to the development of agricultural production and the use of resources. In studies regarding the degree of food security of the world population, it is estimated that the increase in food production at the global level will be approximately 60-80%, which implies higher yields in vegetable crops. (Ray, Deepak & Mueller et al., 2013, [8])

Food production systems need a diverse range of plants, animals, bacteria and fungi necessary for both direct food supply and ecosystem processes within agriculture (soil fertility, pollination, disease and pest control, water cycle) (Potts, S.G. et al., 2016, [7]).

Apart from providing food, biodiversity brings a number of benefits with a positive impact on the quality of life both in terms of people's well-being and mental health and as a source of education or inspiration (White, M. P., et al. 2019, [11]).

We can say that biodiversity has a very important role for humanity. However, in the last period the decline of biodiversity has intensified, the rate of extinction of species being the highest in the history of mankind (Ceballos, G. et. al., 2020, [4]). Thus, in the last 50 years, the global average rate of extinction of plant and animal species has been hundreds of times higher than the average rate of the last 10 million years (Almond, R. E. A. et al., 2020, [1]).

Globally, approximately 1 million plant and animal species are threatened with extinction. IPBES estimates for mammal, bird, fish, amphibian and reptile species show that since 1970 the size of populations has decreased by an average of 68% (IPBES, 2019, [6]).

The loss of biodiversity is observed both in agriculture and in wildlife through the disappearance of some plant and animal species that were important sources of food.

Thus, we are witnessing a steady decline in biodiversity, due to the way we exploit natural resources to support the production, consumption and trade of a globalized economy.

The demand for agri-food products, which is constantly growing, determined by the numerical growth of the population, its incomes and the change in the structure of food consumption, generates a strong pressure on ecosystems and natural resources (Tim G. Benton, et al., 2021, [3]). On the other hand, increasing competition for land, water, energy, overexploitation of natural resources and the effects of climate change will affect the capacity of the agri-food system to produce food (FAO, IFAD, UNICEF, WFP and WHO. 2021, [5]).

Food production, land conversion and intensive agriculture are indicated by most studies as the main causes of biodiversity decline globally. Over the past 50 years, the conversion of natural ecosystems to agricultural land has led to the greatest loss of natural habitats. According to IPBES data, between 1600 and 2019, the land area used in global agriculture increased by about 5.5 times, with crops and livestock occupying about 50% of the total habitable land area.

The rapid development of the livestock sector underpinned much of this conversion (IPBES, 2019, [6]). Since 1970, indicators of vertebrate abundance have registered a rapid decrease against the backdrop of a decrease in the total weight of wild mammals by 82%. The domestication of animals has led to the emergence of a number of farm animal species (especially cows and pigs) that account for approximately 60% of mammal species globally (Bar-On, Y. M., Phillips, R. and Milo, R., 2018, [2]).

The conversion of natural habitats for agriculture ultimately results in the destruction of shelters and food sources on which wild species depend for survival. The International Union for Conservation of Nature identifies agriculture as the main threat to 24,000 of the 28,000 species documented as endangered and included in the "Red List" (Ritchie, H. and Roser, M., 2019, [9]).

Loss of genetic diversity has a negative effect on global food security by making food systems vulnerable to disease, pests and climate change.

Therefore, the loss of biodiversity means more than the simple loss of species, but also involves a reduction in the productivity and resilience of entire ecosystems.

For biodiversity in general and for agriculture, the prognoses are bleak. Genetic erosion of agrobiodiversity is occurring at a very rapid rate due to the need for food and feed caused by population growth.

2. MATERIALS AND METHODS

The topic addressed is a topical one in the current context regarding the challenges related to climate change and ensuring the food security of the world's population.

The paper proposes an analysis of the evolution of ecological agriculture from the perspective of the need for a change in the structure and operation of agriculture to restore the biodiversity of agricultural lands.

The research is based on the principles of ecological agriculture, namely the responsible and efficient use of natural resources with the preservation of biodiversity and ecological balances, the increase of soil fertility and the maintenance of water quality.

The purpose of the research is to provide an image of the link between the level of production, the maintenance of biodiversity on agricultural land and ensuring the food security of the population.

Thus, the analysis took into account the dynamics of organic agriculture, in the last 10 years, from the perspective of the areas used, the number of producers, the consumption of organic products.

3. RESULTS AND DISCUSSIONS

The way food systems affect biodiversity is based on the supply-demand relationship. Worldwide, the increase in food demand has had a significant impact in shaping the supply of food in the sense that with the increase in the income of the population, a greater consumption of food and implicitly of resources has been encouraged.

On the other hand, the supply of food is influenced by the level of production, the selling price and the level of consumption.

Understanding the relationship between supply and demand is important from the perspective of the pressure of intensive agriculture on farmland biodiversity.

In this context, the use of ecological principles in agriculture reduces the pressure on biodiversity under the conditions in which producers registered in the system have the obligation to restore the ecological balance of agricultural holdings.

In fact, organic farming focuses on optimizing actions to improve biodiversity while maintaining the productivity and resilience of agricultural land (Sietz, D., Klimek, S. & Dauber, J. 2022, [10]).

Data from the Research Institute of Organic Agriculture FiBL on the evolution of organic agriculture in 191 countries, show that in 2021 a historical record was reached in terms of the cultivation of agricultural land in an ecological system, the cultivated area representing approximately 1.6% of the total agricultural land of the world.

The analysis of data on the evolution of ecological agriculture indicators globally (table 1) indicates, in the period 1990-2021, an increase of 85.6% of the total area certified organically and in conversion (76.4 million ha in 2021 compared to 11 million ha in 1999). Regionally, the largest share of organic land in total agricultural land was in Oceania (9.7%), Europe (3.6%) and the European Union (9.6%).

It must be said that there are countries where the share of ecological land is higher than the global average (e.g., Liechtenstein with 40.2%, Samoa with 29.1% and Austria with 26.5%).

In 2021 compared to 2020, the total area of ecological land registered an increase of 1.7% (1.3 million ha), most of the analyzed countries reported significant increases (in China, France and Spain) but there were also countries that reported decreases (Argentina, reported 0.38 million hectares less.

Regarding organic land use in 2021, 2.5% (about 50 million hectares) were pastures/grazing areas, 8.1% (6.2 million hectares) were permanent crops, 19% (14.8 million hectares) agricultural crops and the rest of the ecological land surfaces were dedicated to other activities (beekeeping areas, wild plant collection areas).

The analysis of data on the evolution of ecological agriculture indicators globally (table 1) indicates, in the period 1990-2021, an increase of 85.6% of the total area certified organically and in conversion (76.4 million ha in 2021 compared to 11 million ha in 1999).

Regionally, the largest share of organic land in total agricultural land was in Oceania (9.7%), Europe (3.6%) and the European Union (9.6%). It must be said that there are countries where the share of ecological land is higher than the global average (e.g., Liechtenstein with 40.2%, Samoa with 29.1% and Austria with 26.5%).

Table 1: Organic agriculture in 2021

Indicator	**World** (191 countries)	**Top countries**
Organic farmland	**2021**: 76.4 million ha **1999**: 11 million ha	Australia: 35.7 million ha Argentina: 4.1 million ha France: 2.8 million ha
Organic share of total farmland	**2021**: 1.6 %	Liechtenstein: 40.2% Samoa: 29.1 % Austria: 26.5 %
Increase of organic agricultural land 2020/2021(%)	1.3 million ha; +1.7 %	China: 319000 ha (+13 %) France: 228000 ha (+9 %) Spain: 198000 ha (+8%)
Wild collection and further non-agricultural areas	**2021:** 29.7 million ha **1999:** 4.1 million ha	Finland: 6.9 million ha Zambia: 2.5 million ha Namibia: 2.3 million ha
Producers	**2021**: 3.7 million producers **1999**: 200'000 producers	India: 1'599'010 Uganda: 404'246 Ethiopia: 218'175
Organic market	**2021**: 124.8 billion euros **2000**: 15.1 billion euros	USA: 48.6 billion euros Germany: 15.9 billion euros France: 12.7 billion euros
Per capita consumption	**2021**: 15.7 euros	Switzerland: 425 euros Denmark: 384 euros Luxembourg: 313 euros

Source: **FiBL & IFOAM, 2023** [12]

The analysis of data on the evolution of ecological agriculture indicators globally (table 1) indicates, in the period 1990-2021, an increase of 85.6% of the total area certified organically and in conversion (76.4 million ha in 2021 compared to 11 million ha in 1999).
Regionally, the largest share of organic land in total agricultural land was in Oceania (9.7%), Europe (3.6%) and the European Union (9.6%). It must be said that there are countries where the share of ecological land is higher than the global average (e.g., Liechtenstein with 40.2%, Samoa with 29.1% and Austria with 26.5%).
Research Institute of Organic Agriculture FiBL, data on indicators of organic agriculture in Europe (table 2), show that in 2021 the total area of land used in organic agriculture was 17.8 million hectares, which represents approximately 3.6% of the total agricultural land.
Regarding the use of agricultural land cultivated in the ecological system, 47.2% of the total area is with vegetable crops (cereals - 2.9 million ha, fodder crops - 2.6 million ha and oleaginous plants - 0.9 million ha), 11.2% are permanent crops (olives - 0.6 million ha, grapes - 0.4 million ha and walnuts - 0.4 million ha) and 38.8% are permanent grasslands (6.9 million ha).
Against the background of the increase in the number of producers registered in organic agriculture in Europe (442.274 producers), in 2021, the organic products market in Europe reached 54.5 million euros and the value of the average consumption per inhabitant of organic products at 65.7 euros, with the highest consumption value recorded in Switzerland (424 euros/capita).

Table 2: European organic agriculture in 2021

Indicator	**Europe**	**European Union 27**
Organic farmland	17.8 million ha	15.6 million ha
Organic share of total farmland	3.6 %	9.6 %
Land use	Arable crops: 8.4 million ha Permanent crops: 2.0 million ha Permanent grassland: 6.9 million ha	Arable crops: 7.0 million ha Permanent crops: 1.8 million ha Permanent grassland: 6.5 million ha
Top arable crop groups	Cereals: 2.9 million ha Green fodder: 2.6 million ha Oilseeds: 0.9 million ha	Green fodder: 2.5 million ha Cereals: 2.4 million ha Dry pulses: 0.5 million ha
Top permanent crop groups	Olives: 0.6 million ha Grapes: 0.4 million ha Nuts: 0.4 million ha	Olives: 0.6 million ha Grapes: 0.4 million ha Nuts: 0.4 million ha
Producers	442274	378226
Processors	87676	82500
Importers	7590	6378
Retail sales	54.5 billion euros	46.7 billion euros
Per capita consumption	65.7	104.3 euros

Source: **FiBL & IFOAM, 2023** [12]

If we analyze the evolution of organic agriculture in the European Union, Eurostat data shows that in the period 2012-2020, the share of agricultural land in organic agriculture registered an increase of over 50%, the agricultural area cultivated organically in 2020 reaching 74.9 million hectares, which it represents 9.1% of the agricultural area used in the EU and 19.7% of the agricultural area used worldwide.
In terms of land use for organic farming, the largest share is for permanent pastures (42%), followed by fodder crops (17%), cereals (16%) and permanent crops (11%).
Animal husbandry in an ecological system did not register the same evolution, with organic animal production representing, depending on the sector, between 1% and 7% of the total animal production of the European Union.
Data on production levels from organic farms show average production levels 5-30% lower than

conventional farms. On the other hand, EU accounting data (FADN) show that the level of costs of plant protection products and fertilizers are lower by 45-90% compared to conventional agriculture.

However, the incomes generated by organic farms are equal to or higher than conventional ones due to higher selling prices and high levels of subsidies from the EU's Common Agricultural Policy (CAP). For example, in 2020, for 61.6% of the EU's ecologically certified lands, the subsidy from the CAP was on average 144 EUR/ha to which 79 EUR/ha of national co-financing was added.

In Romania, organic farming has grown year by year against the background of increasing demand for organic products and advantages regarding subsidies and the selling price of products.

If we analyze the data of the National Institute of Statistics regarding the evolution of organic agriculture in Romania, we notice that in the period 2010-2020 the agricultural area used in the ecological system increased by approximately 257% (468.9 thousand ha in 2020 compared to 182.7 thousand ha in 2010) and of producers registered in organic agriculture by approximately 320% (10,210 producers registered in organic agriculture in 2020 compared to 2010). This increase in the number of producers has led to the diversification of the range of organic products.

Figure 1 shows the evolution of the agricultural area used, ecologically certified and in conversion, respectively the share in the agricultural area used in Romania and the EU-27.

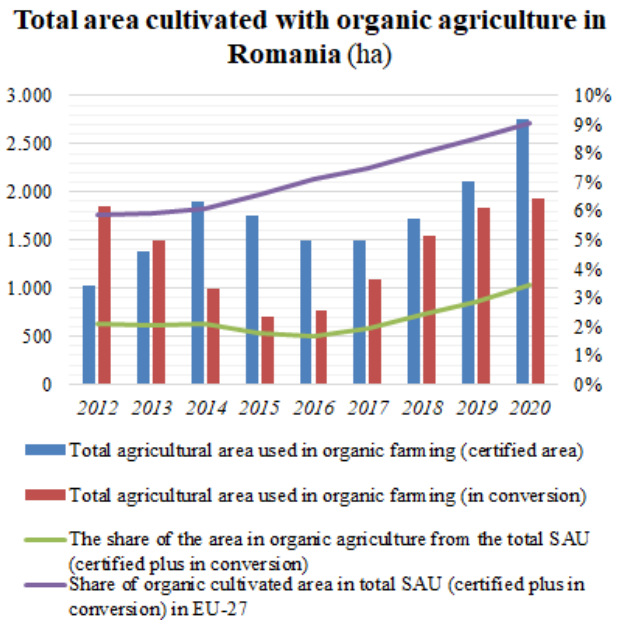


Figure 5: Evolution of the area with ecological agriculture in Romania. *Source:* Eurostat

Eurostat data for Romania indicate a share of ecologically used agricultural area (certified + conversion) in total agricultural area almost three times lower than the EU-27 average (3.5% in Romania compared to 9.1% EU average).

The data of the Ministry of Agriculture and Rural Development (MARD), regarding the evolution of the total area registered in organic agriculture in Romania, show that in the period 2010-2021 the total area registered increased from 182.7 thousand ha in 2010 to 580.8 thousand ha in year 2021 (table 3). Of the total area registered (certified and in conversion) in 2021, the total area certified in organic agriculture represents approximately 60%, the remaining 40% being the area registered in various degrees of conversion. By types of crops, in 2021 the largest area cultivated in the ecological system is that with pastures and hayfields (37% of the total area), followed by the area cultivated with cereals (24%) and that with industrial plants (19.7%).

Regarding the evolution of ecologically certified animal herds, in the period 2010-2021, MADR data show an important increase in the number of ecologically certified animals. During the analyzed period, the total number of ecologically certified cattle increased from 5.4 thousand heads in 2010 to 23.3 thousand heads in 2021, similar increases being also recorded in organically certified laying hens (186.7 thousand heads in 2021 compared to 21.6 thousand heads in 2010). In sheep and goats there were decreases in the herds of organically certified animals (-26.7% in sheep and -1.2% in goats) but there were significant increases in the number of ecologically certified bee families.

Table 3: Data on organic agriculture in Romania

Indicator	2010	2015	2020	2021
Producers	3155	12231	10210	12231
Organic farmland (thousand ha)	182.7	245.9	468.9	580.8
Cattle (head)	5358	29313	19870	23339
Sheep (head)	18883	85419	13189	13837
Goat (head)	1093	5816	830	1080
Poultry (head)	21580	107639	171391	214104
Bee families	64836	81583	170789	171564

***Source:* MARD**

4. CONCLUSIONS

The global COVID-19 pandemic has led to an increase in demand for organic products, with sales of organic products experiencing significant growth.

In the year 2021, the global market for organic products has reached approximately 125 billion euros, with an average per capita consumption value of 15.7 euros.

In Europe, organic farming has grown steadily, supported by the growing demand for organic products and the Common Agricultural Policy of the European Union. Over 52% of organic farms are large (over 100 ha/farm), are oriented towards monoculture, have a high

level of mechanization and specialization, which limits biodiversity on the land used.

In Romania, organic agriculture has seen an upward evolution in recent years, both in terms of plant and animal production. The development of organic farming has been encouraged by consumer behavior towards healthy products and the advantages of subsidies and selling price. However, both the agricultural area used in the organic system and the number of organically certified animals are below the European average.

As a method of agricultural production with a limited impact on the environment, organic farming has the ability to restore biodiversity on cultivated land. The ecological exploitation of agricultural land, on which the conservation of biodiversity depends, is the way to a sustainable agriculture.

5. REFERENCES

[1] Almond, R. E. A., Grooten, M. and Petersen, T. (eds), 2020; Living Planet Report 2020: Bending the curve of biodiversity loss, Gland, Switzerland: WWF, https://livingplanet.panda.org/en-gb

[2] Bar-On, Y. M., Phillips, R. and Milo, R., 2018; 'The biomass distribution on Earth', Proceedings of the National Academy of Sciences of the United States of America (PNAS), 115(25): pp. 6506–11.

[3] Tim G. Benton, Carling Bieg, Helen Harwatt, Roshan Pudasaini and Laura Wellesley, 2021; Food system impacts on biodiversity loss: Three levers for food system transformation in support of nature, FAO, https://www.fao.org/agroecology/database/detail/en/c/1394568/

[4] Ceballos, G., Ehrlich, P. R. and Raven, P. H., 2020); 'Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction', Proceedings of the National Academy of Sciences, 117(24): 13596–13602.

[5] FAO, IFAD, UNICEF, WFP and WHO. 2021. The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO.

[6] IPBES, 2019; Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Guèze, M., Agard, J., Arneth, A., Balvanera, P., Brauman, K. A., Butchart, S. H. M., Chan, K. M. A., Garibaldi, L. A., Ichii, K., Liu, J., Subramanian, S. M., Midgley, G. F., Miloslavich, P., Molnár, Z., Obura, D., Pfaff, A., Polasky, S., Purvis, A., Razzaque, J., Reyers, B., Chowdhury, R. R., Shin, Y. J., Visseren-Hamakers, I. J., Willis, K. J. and Zayas, C. N. (eds), Bonn, Germany: IPBES Secretariat, https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf

[7] Potts, S. G., Imperatriz-Fonseca, V., Ngo, H. T., Aizen, M. A., Biesmeijer, J. C., Breeze, T. D., Dicks, L. V., Garibaldi, L. A., Hill, R., Settele, J. and Vanbergen, A. J., 2016; 'Safeguarding pollinators and their values to human well-being', Nature, 540: pp. 220–29.

[8] Ray, Deepak & Mueller, Nathaniel & West, Paul & Foley, Jonathan, 2013; Yield Trends Are Insufficient to Double Global Crop Production by 2050. PloS one. 8. e66428.

[9] Ritchie, H. and Roser, M. 2019; 'Environmental impacts of food and agriculture', Our World in Data, September 2019, https://ourworldindata.org/environmental-impacts-of-food#environmental-impacts-of-foodand-agriculture

[10] Sietz, D., Klimek, S. & Dauber, J., 2022; Tailored pathways toward revived farmland biodiversity can inspire agroecological action and policy to transform agriculture. Commun. Earth Environ., 3, 211.

[11] White, M. P., Alcock, I., Grellier, J., Wheeler, B. W., Hartig, T., Warber, S. L., Bone, A., Depledge, M. H. and Fleming, L. E., 2019; 'Spending at least 120 minutes a week in nature is associated with good health and wellbeing', Scientific Reports, 9(7730).

[12] Willer, Helga, Bernhard Schlatter and Jan Trávníček (Eds.), 2023; The World of Organic Agriculture. Statistics and Emerging Trends 2023. Research Institute of Organic Agriculture FiBL, Frick, and IFOAM – Organics International, Bonn, https://www.fibl.org/fileadmin/documents/shop/1254-organic-world-2023.pdf