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THE QUALITY OF ENVIRONMENTAL FACTORS AND ORGANIC AGRICULTURE

ABSTRACT

Greenhouse gas emissions are the main cause of the global climate crisis. The EU is the fourth largest emitter of greenhouse gases in the world, after China, the United States and India, which determined the setting of the Community objective of reducing emissions by 55% by the year 2030 and reaching climate neutrality by 2050.

In Romania, agriculture ranks second in terms of greenhouse gas emissions and can play an important role in ensuring its own climate neutrality and can contribute to neutralising the effects produced by other anthropogenic activities.

The quality of environmental factors influences the quantity, but especially the quality of food. Organic agriculture is an essential tool in protecting the quality of the environment, by conserving soil, water quality and supporting biodiversity, but also a tool in ensuring a healthy diet.

The paper is intended to be an analysis of the quality of the main environmental factors and evolution of organic agriculture in Romania.

Key words: environmental factors, climate neutrality, organic agriculture

JEL Classification: Q20, Q10, Q54

1. INTRODUCTION

Greenhouse gas emissions are the main cause of the global climate crisis. These come from natural sources, but the largest contribution comes from anthropogenic sources.

The quality of environmental factors influences the quantity and mainly quality of food. Soil quality is affected by a number of factors limiting its productive capacity, which most often act cumulatively. Water quality is influenced by industrial activities, urban agglomerations and agricultural activities, mainly those in livestock production.

Organic farming is an essential tool in protecting the quality of environmental factors, through the conservation of soil and water quality and supporting biodiversity, as well as an important tool in ensuring a healthy diet.

The “Farm to Fork” Strategy presents a set of actions to increase the share of organic agriculture in the EU, with the main objective to boost organic production to reach 25% of the EU’s agricultural land use by 2030. The EU member states are encouraged to develop national plans for organic agriculture, and to achieve them, member states have been invited to establish national target values. Romania, through its national plan, aims to increase the area under organic farming system to 800,00 ha by the year 2030, *i.e.* 6% of its utilized agricultural area (MADR, 2023).

The paper aims to analyse the quality of the main environmental factors and the evolution of organic agriculture in Romania.

2. STATE OF KNOWLEDGE

Organic agriculture is a sector with real development potential in Romania, being an essential tool for environmental protection, by conserving the soil, improving water quality and supporting biodiversity.

The environmental impact of organic farming has received the most attention from researchers and there is a growing consensus that it provides more environmental benefits compared to conventional farming (Petersen *et al.*, 2006; Cobb *et al.*, 1999). Thus, “positive effects on the biological quality of soil have been noticed in the organic farming system as compared to conventional systems” (Puissant *et al.*, 2021). When biodiversity in ecological farming systems and conventional farming systems is analysed on comparative basis, a greater overall abundance of birds, plants and organisms is found on organically farmed land (Crowder *et al.*, 2012). A series of studies reveal that “species richness in organic farming is up to 34% higher than in conventional farming systems” (Smith *et al.*, 2019).

Therefore, the importance of organic agriculture has gradually increased and is in continuous expansion, supported by the growing demand of consumers, who are interested in staying healthy through the consumption of natural food. All these add to the requirements of society for sustainable agriculture development, as well as to the many favourable effects of organic agriculture at the level of farm, environment and biodiversity.

The International Federation of Organic Agricultural Movements (IFOAM) formulated a simple but comprehensive definition of organic agriculture, namely: “organic agriculture is a production system that sustains the health of soils, ecosystems and people”. Organic agriculture relies on “ecological systems, biodiversity and cycles adapted to local conditions, rather than the use of chemical inputs with adverse effects”. The same definition shows that “organic agriculture combines tradition, innovation and science to benefit the shared environment and promotes fair relationships and good quality of life for all involved”.

Organic agriculture “produces safe and nutritious food while protecting the environment and sustainably using natural resources, providing a healthy food system for Romania and organically certified food supplies with high value added” (MADR, 2023).

3. MATERIAL AND METHOD

The present study consists of two parts; the first part is an analysis of conventional agriculture influence on the quality of the main environmental factors in Romania and the second part is an analysis of organic agriculture, worldwide, at EU level and in Romania.

For the first part available data were used from the Ministry of Environment, Waters and Forests (MMAF), (Romania. National Inventory Report, 2022) and from the National Environmental Protection Agency (ANPM), (Annual Reports on the State of Environment in Romania). The period of analysis was 2010–2021 and greenhouse gas emissions generated by agricultural activities were taken into consideration, together with the influence of conventional agriculture on the quality of waters, soil and biodiversity.

For the second part, on the evolution of organic agriculture worldwide and in the European Union, data were extracted from the latest report by the Research Institute of Organic Agriculture (FiBL) and the International Federation of Organic Agricultural Movements (IFOAM). For the analysis of organic agriculture evolution in Romania, available data from the Ministry of Agriculture and Rural Development (MADR) for the period 2016-2021 were used.

The methodology used for the purpose of this study included two types of tools: data collection and quantitative analysis. Data were processed, analysed and interpreted and formed the set of information necessary to carry out this study.

4. RESULTS AND DISCUSSIONS

Environmental facts interact with each other and have an impact of different intensities on each other. Disequilibria in their quantity and quality may lead, among other things, to disruptions in the society's supply chain.

Greenhouse gas emissions and climate change

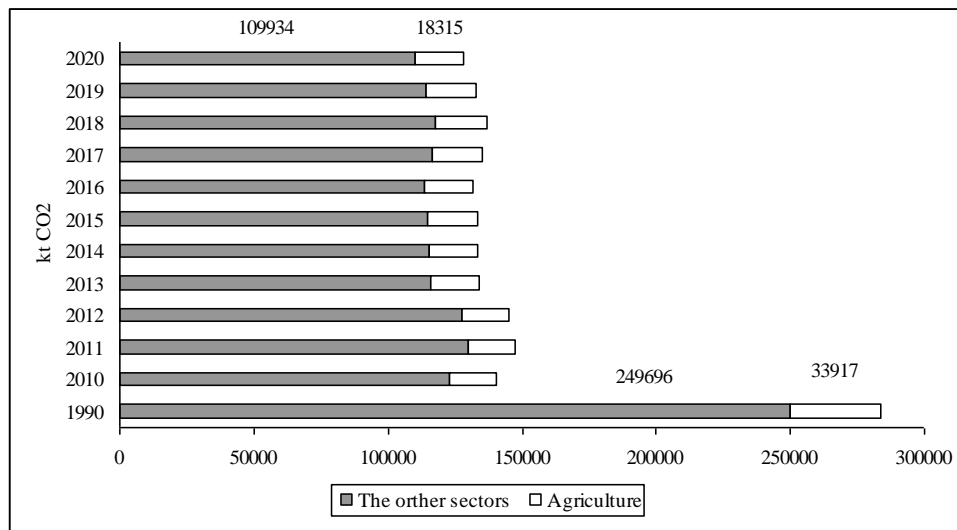
Greenhouse gas emissions have been associated to climate change. Natural absorbers remove between 9.5 and 11 Gt carbon dioxide (CO₂) per year; in the year 2020, global emissions reached 36–38 Gt CO₂/year. In other words, the world's

forests, seas and oceans can absorb a certain amount of carbon dioxide, naturally, but at global scale emissions are almost 4 times higher.

Globally, the territories responsible for more than 60% of greenhouse gas emissions are China (27%), the United States (11%), India (7.9%), EU (7.3%) and Russia (6.8%), Romania contributing by 0.3% to global greenhouse gas emissions.

To combat climate change, the EU has committed to reduce greenhouse gas emissions (carbon emissions) by 55% by the year 2030 and become climate neutral by 2050. The EU ranks fourth in the world in terms of greenhouse gas emissions, and the EU countries responsible for about 63% of total greenhouse gas emissions are Germany (17.5%), France (13.2%), Poland (10.8%), Italy and Spain (with 10.7% each). In the year 2020, Romania contributed by 3.7% to total greenhouse gas emissions of the EU.

In the year 2020, in the EU, the energy sector was responsible for 77% of the greenhouse gas emissions, followed by agriculture and industry with 10% each and the waste management sector with 3%. In the same year, in Romania, the energy sector also had the greatest contribution to greenhouse gas emissions (66.2%), agriculture contributed by 16.7%, ranking second, followed by industry (11.7%) and waste management (5.4%).



Source: MMAP, (2022), *Romania's Greenhouse Gas Inventory 1989–2020*.

Figure 1. Evolution of greenhouse gas emissions in agriculture and the other sectors of the economy in Romania, in the year 2020.

Romania's greenhouse gas emissions in the year 2020 were 2.2 times lower than in 1990. Greenhouse gas emissions decreased in physical terms, both in agriculture and in the other sectors of the economy, due to the decline in all economic sectors. Although both agriculture and the other economic sectors

generated fewer greenhouse gas emissions, the percentage by which agriculture contributed to total greenhouse gas emissions increased, from 13.6% in 1990, to 16.7% in 2020, which means that the activities in this sector produced more pollution.

The agricultural sector that produced the most greenhouse gas emissions was livestock production, due to methane (CH₄) from enteric fermentation and from manure management, both contributing by 48.7% to total greenhouse gas emissions from this sector.

Table 1

Contribution of agricultural sub-sectors to greenhouse gas emissions, in 2020

	Agriculture I soils	Field burning of agricultural residues	Enteric fermentation	Manure management	Other
%	46.6	3.9	39.5	9.2	0.8

Source: Own calculation based on data from *Romania's Greenhouse Gas Inventory 1989–2020*.

Next to livestock production, agricultural soils treated with nitrogen contribute to greenhouse gas emissions, due to the nitrogen protoxide (N₂O) coming mainly from chemical and natural fertilisers, urine and manure from free-range grazing animals.

In the period 2010–2020, in Romania, the greenhouse gas emissions per capita were below the EU average. The EU target on greenhouse gas emissions for the year 2030 is 5 tonnes/capita.

Table 2

Greenhouse gas emissions per capita, in the EU and Romania

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	tonnes/capita										
EU	9	8.7	8.5	8.3	8	8.2	8.2	8.4	8.1	7.8	7
RO	4.7	5	4.8	4.3	4.1	4.2	4	4.3	4.5	4.4	4

Source: NIS – National Institute of Statistics, *Sustainable Development Indicators – Environment*.

The low level of greenhouse gas emissions per capita in Romania throughout the investigated period has placed our country in a favourable situation compared to the EU and at the same time below the EU established target.

Soil quality

Soil is a renewable source on which our food supply depends. There is both a direct and indirect influence of climate on soil. Climate has a great direct influence on the processes of wind and water erosion of soils through its main components, namely wind and water.

Among the most important soil quality limiting factors we can list the following: drought, which affects about 7.1 mil. ha; water erosion, which affects 6.3 mil. ha and which, together with landslides, causes soil losses of up to 41.5 t/ha/year; soil compaction affecting 6.5 mil. ha; low and very low humus reserve in soil, which affects 7.5 mil. ha (ANPM, 2022).

Their negative influences are reflected in the deterioration of soil characteristics and functions, such as bioproductive capacity, thus affecting the quality of agricultural products and food security.

Chemical fertilisers, together with pesticides and antibiotics, are usually used in agriculture to produce food. Yet their excessive and abusive use negatively impacts ecosystems, as well as the health of crops, animals and people.

The frequency of unfavourable weather phenomena has increased in recent years, impacting agricultural productivity and also soil quality, and increasing large areas are facing an increase in aridity. Thus, the desertification phenomenon has emerged, which leads to the diminution of food production, to soil infertility and reduction of its carbon storage capacity. According to data from the National Strategy for the prevention and combating of desertification and land degradation, the area exposed to desertification represents about 30% of Romania's total area, located mostly in Dobrogea, in Moldova, in the southern part of the Romanian Plain and in the Western Plain. The affected land areas are mainly used in agriculture.

A high carbon level means good soil conditions for agriculture, while a low level of organic carbon impacts on soil fertility, water retaining capacity and its resistance to compaction. According to Eurostat data, arable soils in Romania have a lower carbon storage capacity, with an average organic carbon content of 20.1 g/kg, under the EU average of 43.1 g/kg.

Water quality

Romania's natural water resources are represented by surface waters (inland rivers and the Danube) and groundwater reserves.

In Europe, most water is abstracted from surface waters. The abstraction rates are higher during the vegetation period. In Europe, the largest amount of water is used for agriculture (58%), industry (29%), households (10%) and the rest for other uses.

For Romanian water users, inland rivers have the highest share in providing the necessary water resources. The Danube holds primacy in terms of total volume of water resource, but its location in the southern part of the country makes the usable water resource be used only at local level. The most important use of the water resource provided by the Danube has been in agriculture, for irrigations.

Romania's water resources sum up 134.6 billion m³, out of which the usable resource is about 38.35 billion m³, which comes from inland rivers 13.68 billion m³, the Danube 20 billion m³ and groundwater 4.67 billion m³.

The groundwater resource in Romania was estimated at 9.68 billion m³/year, of which 4.74 billion m³/year phreatic waters and 4.94 billion m³/year deep underground water. The groundwater from the first aquifer layer is used for irrigations and industry, while water collected from springs and deep boreholes is used as water supply for the population.

Agriculture depends on weather and climate conditions to a great extent, and their extreme variations are reflected in the large volumes of water that this sector uses.

Surface water and groundwater quality is influenced by wastewater and untreated water discharges from urban, industrial and agricultural sources. The agricultural sources are the livestock farms that do not have appropriate facilities for manure storage / handling / use; the farms that use pesticides and do not comply with the legislation into effect; the population households, mainly those that have animals in their backyards and do not have appropriate manure discharge systems (thus allowing the nitrate leaching from manure into soil and water) and are not subject to obtaining an environmental authorisation.

Biodiversity

Biodiversity means “variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part”, according to the definition from the Convention on Biological Diversity ratified in Rio de Janeiro in 1992.

Romania has brought an extremely valuable natural capital to the European Union, with numerous species and animals that are in danger of extinction in other parts of Europe.

According to the National Environment Protection Agency (ANPM), in Romania, the natural and semi-natural ecosystems represent 47% of the country's area, agricultural ecosystems account for 45%, while buildings and infrastructure represent 8%.

Three categories of protected natural areas can be found on Romania's territory:

1. Protected natural areas of national interest: scientific reserves, natural monuments, natural reserves (916 in number, total area 3.1 mil. ha), national parks (13 in number, total area 317 thousand ha), natural parks (16 in number, total area 770 thousand ha).
2. Protected natural areas of international interest: natural sites of the world natural and cultural heritage (Romania has only one such site), wetlands of international importance (19 in number, on 1.1 mil. ha), biosphere reserves (3 in number, with a total area of 662 thousand ha).
3. Protected natural areas of Community interest – Natura 2000 sites: sites of Community interest – SCI (435, total area 4.6 mil. ha), avifaunistic special protection areas – SPA (171, total area 3.9 mil. ha).

In the period 2010–2021, according to Natura 2000 Barometer, the situation of Natura 2000 sites improved, their number and area increasing. As regards the adoption of Management Plans, although slight progress has been made, less than

one third of Natura 2000 sites have such approved plans, which hinders their effective management.

Organic agriculture

Organic farming is a method by which food is produced using natural substances and processes, thus having a lower impact on the environment, as it encourages the responsible use of energy and natural resources, preserving biodiversity and ecological balance, increasing soil fertility and maintaining water quality.

Organic agriculture worldwide

According to data from the latest FiBL report, in the year 2021, a total area of 76.4 million hectares was organically managed worldwide, including the areas under different stages of conversion to organic farming, which represented 1.6% of agricultural land worldwide. Among the regions with the largest areas under organic farming system, Oceania ranked first (36.0 mil. ha), which had almost half of the organically managed area worldwide, followed by Europe (23% of total). Australia (35.7 mil. ha), Argentina (4.1 mil. ha) and France (2.8 mil. ha) were the countries with the largest areas under organic farming. By area cultivated under organic farming system, Romania (578,718 ha) ranked 16th in the world. In terms of crop structure worldwide, two-thirds were represented by grassland, followed by arable land and land under permanent crops. Worldwide, the number of organic farmers totalled about 3.7 million, the leader being India, with 1.6 million.

The report also states that worldwide, the sales of organic food and alcoholic beverages reached over 125 billion EUR in the year 2021, the countries with the largest sales markets for organic products being the USA (48.6 billion EUR), Germany (15.9 billion EUR) and France (12.7 billion EUR). The largest single market was the United States (39% of the global market), followed by the European Union (37%) and China (9.1%).

The average value of the consumption of organic products per capita/year was 15.8 EUR. The top countries with the largest consumption of organic products per capita/year were Switzerland (418 EUR), Denmark (334 EUR) and Luxembourg (285 EUR).

Organic agriculture in the European Union

In the year 2021, in the European Union, the area used for organic production totalled 15.6 mil. ha, the equivalent of 9.6% of its total utilised agricultural area. The countries with the largest areas under organic farming were France and Spain (2.8 mil. ha each), followed by Italy (2.2 mil. ha), which together accounted for almost half of the organically managed area in the EU. Romania ranked 8th in terms of area used for organic production.

In the EU, arable land under organic farming totalled 7.1 mil. ha, followed by grassland with 6.5 mil. ha and land under permanent crops with 1.8 mil. ha. The sales of organic products totalled 46.7 billion EUR; the countries with the largest

sales market for these products were Germany (15.9 billion EUR) and France (12.7 billion EUR). There were about 380 thousand organic farmers in the European Union, the most numerous in Italy and France, countries where the most numerous processors of organic products were also found.

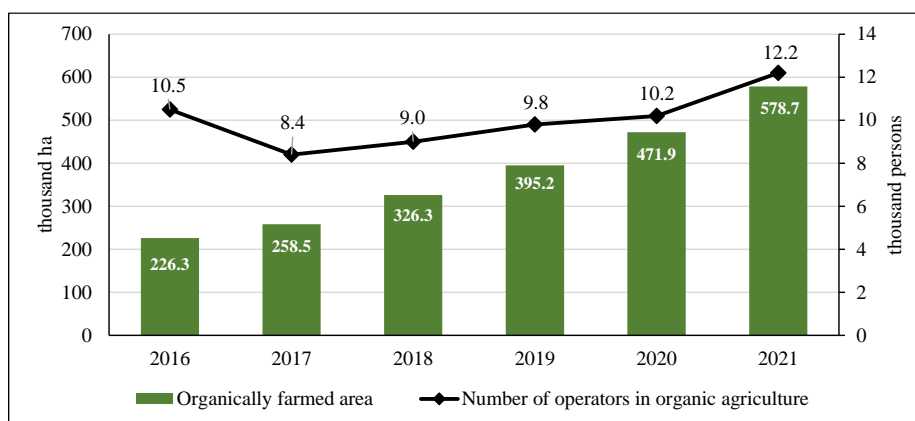
According to the above-mentioned report, in the year 2021 in the EU, the average value of consumption of organic products per capita/year reached 104.3 EUR; the counties with the higher consumption of organic products per capita/year were Switzerland (425 EUR) and Denmark (384 EUR).

Organic agriculture in Romania

In Romania, organic agriculture has received support under the two NRDPs, through different measures. The National Strategic Plan 2023–2027 provided for a total financial allocation for organic agriculture of 389.12 mil. EUR, namely 162.6 mil. EUR for financing conversion schemes and 226.52 mil. EUR (MADR, 2023) for financing commitments to maintain organic farming practices.

In the period 2016–2021, in Romania, the area under organic farming increased 2.5 times, in the year 2021 representing 4.5% of total utilised agricultural area in Romania.

The evolution of the number of certified operators in organic agriculture fluctuated, to reach a peak in 2021, possibly as the result of funds allocated to this sector. Throughout the analysed period, more than 94% of organically certified operators were farmers, followed by organic traders and processors. The low share of processors of organic products indicates that the largest part of organic production is exported under the form of raw products. That is why the main objectives for the development of organic agriculture should be, on the one hand, the increase of organically cultivated areas, and on the other hand, the processing of organic products to obtain products with high value added.



Source: MADR, 2022.

Figure 2. Evolution of cultivated area and operators in organic agriculture.

Changes were produced in the crop structure in the analysed period. In the year 2016, cereals prevailed in the structure of organic crops (33.2%), followed by pastures and hayfields (25.5%) and industrial crops (23.6%). In the year 2021, pastures and hayfields prevailed in the crop structure (37%), followed by cereals (24%) and industrial crops (19.8%).

Table 3

Crop structure in organic agriculture

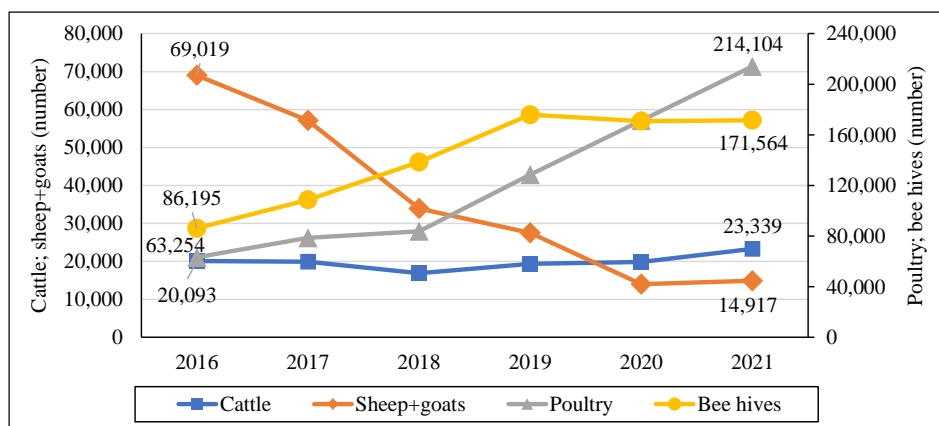
	2016	2017	2018	2019	2020	2021	– thou. ha – 2021/2016 (times)
Area	226.3	258.4	326.3	395.2	471.9	578.7	2.6
Cereals	75.2	84.8	114.4	126.8	134.2	139.4	1.9
Grain legumes	2.2	5.0	8.8	7.4	5.7	5.9	2.7
Roots and tubers	0.7	0.7	0.5	0.5	0.4	0.3	0.4
Industrial crops	53.4	72.4	80.2	78.4	91.6	114.4	2.1
Green crops	14.3	20.4	28.3	37.7	53.8	74.7	5.2
Other crops in arable land	0.3	0.08	0.1	0	0	0.2	0.7
Vegetables	1.2	1.5	1.0	0.8	0.8	1.2	1.0
Permanent crops	12.0	13.2	18.6	22.2	22.2	21.2	1.8
Pastures and hayfields	57.6	50.7	66.9	115.4	158.1	214.7	3.7
Uncultivated land	9.5	9.7	7.6	6.1	5.2	6.8	0.7

Source: MMAP, ANPM, 2022.

The largest increase of areas under organic crops was noticed in green crops (5.2 times) and in pastures and hayfields (3.7 times). The increase of the area under organic pastures and hayfields is due to subsidies provided to farmers for these areas.

The organically certified livestock herds had oscillating developments. Cattle were the most numerous organically certified animals, and their number increased. Not the same thing can be said about the evolution of the number of organically certified sheep and goats that dramatically decreased in the analysed period.

Dairy products and eggs are the main ecologically certified animal products, to which organic honey is added. Organic cow milk production is relatively stable, while the organic ewe and goat milk has decreased in recent years, with the decrease of herds.



Source: Author's processing of MADR data, 2022.

Figure 3. Evolution of organically certified animals.

The number of organically certified poultry significantly increased, being by almost 3.4 more numerous in 2021 as compared to 2016; the reason behind this is that there is a great demand for organic eggs and small enterprises can launch organic production with low investments and a stable cash flow.

The number of organically certified bee families almost doubled in the analysed period, resulting in an increase of organic honey production. Thus, organic honey production reached 4,480 tonnes in 2021, double compared to that in 2020.

The upward trend of organic production of cow milk, eggs and honey is driven by the cooperation structure in the value chain (production, consolidation, processing and trade) for these products, which unfortunately is missing for the other products.

In the year 2021, in total organically registered area, 57.4% was represented by the organically certified area, the remaining 42.6% being the area in conversion to organic farming.

5. CONCLUSIONS

Agriculture has a double role, contributing to and being affected by climate change. Year-to-year climate variability is one of the main causes of the low yields of crops and one of the inherent risks of agriculture.

Greenhouse gases are associated with climate change. In recent years, almost four times more greenhouse gases have been released into the atmosphere than natural sources can absorb. The countries with the greatest greenhouse gas emissions are China, the United States, India and the European Union. At global level, Romania contributes by approximately 0.3% to greenhouse gas emissions.

From 1990 to 2020, total greenhouse gas emissions decreased both in the EU and in Romania, in particular, due to the decline in the activity of all economic sectors. In the year 2020, agriculture contributed by 10% to greenhouse gas emissions in the EU. In Romania, the contribution of agriculture to total greenhouse gas emissions increased from 13.6% in the year 1990, to 16.7% in 2020. The livestock sector continues to be the largest contributor to greenhouse gas emissions, due to enteric fermentation and poor manure management.

The low greenhouse gas emissions per capita in Romania place our country in a favourable position compared to the European Union and below the target established at Community level of 5 tonnes/capita/year by the year 2030.

In recent years, increasingly large areas have been facing the phenomenon of aridification in Romania, which affects agricultural productivity, farmers' incomes and soil quality in particular. Arable soils in Romania have a lower carbon storage capacity, having an average organic carbon content of 20.1 g/kg, lower than the EU average of 43.1 g/kg.

Industry is the economic sector that uses the largest amounts of water, followed by agriculture, while population households rank last. Water quality is influenced by untreated or insufficiently treated wastewater discharges, from urban, industrial and agricultural sources.

Romania contributes to European biodiversity with a very valuable natural capital, with numerous and varied species of plants and animals, some of them in danger of extinction in other countries in Europe. A great number of protected natural areas are found on Romania's territory, which has increased significantly since our country joined the Natura 2000 network. Unfortunately, only one third of protected areas of Community interest have approved management plans, so that their management is less effective.

Organic farming is a method that aims to produce food using natural substances and processes, so that its environmental impact is lower, as it encourages the responsible use of energy and natural resources, preserving biodiversity and ecological balance, increasing soil fertility and maintaining water quality.

In the year 2021, worldwide, the area under organic farming accounted for 1.6% of the utilised agricultural area; in the European Union, the area under organic farming accounted for 9.6% of the utilised agricultural area, while in Romania 4.5%.

In the period 2016–2020, in Romania, the area under organic farming increased 2.5 times, with a maximum number of registered operators in the year 2021, out of which farmers had the highest share (over 95%). The low number of processors of organic products indicates that the largest part of organic production is exported in the form of raw products. That is why the main objectives for the development of organic agriculture should be the increase of areas under organic farming and of organic products with high value added.

The areas under cereals and oil crops represent almost half of the organically certified area, followed by the areas under pastures and hayfields. Dairy products and eggs are the main organic products of animal origin, to which organic honey production is added.

Organic agriculture has the potential to contribute to the protection of environmental factors, to biodiversity conservation and fight against climate change, thus providing public goods and at the same time serving a growing market.

The upward trend of areas under organic farming in latest years confirms that the target established by Romania for the year 2030 in terms of area under organic farming can be reached and even exceeded.

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