

AGROECOLOGY: A REAL OPPORTUNITY TO FIGHT AGAINST THE CLIMATE CHALLENGES

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Abstract

Weather changes significantly affect people's lives. Climatic data recorded so far indicates a progressive warming of the weather. Agriculture is one of the most affected branches due to its dependence on the evolution of the weather throughout the entire plants growing season. Agroecology can be one of the correct and concrete answers to the challenge of climate change, as this type of agriculture respects the natural balance of Earth, reducing human impact as much as possible. The current research presents the situation of agroecology in our country, as well as the evolution of organically grown crops areas. Although over the last 10 years, in Romania, the trend has fluctuated slightly with both decreases and increases, starting with 2017 the evolution of organic cultivated areas follow a positive trend. Organic farming follows the same positive trend in European Union and also worldwide. As concerns the types of organic crops grown in Romania in 2019 the largest area is occupied by cereals (32.09%), followed by permanent crops of meadows and hayfields (29.2%), then by industrial crops (19.82%). The smallest ratios of organically cultivated areas are represented by tuberous and root plants, as well as vegetables. Wheat is the most widespread crop, followed by maize, sunflower and barley. Other organic crops in our country, but cultivated on smaller areas, are rye, triticale, oats, rice, soybeans, potatoes and sugar beets. The increase of the surfaces on which the agroecology extends corresponds to the necessity of the humanity to return to the natural state, just how agriculture was from its beginnings, in order to slow down the climatic changes.

Key words: agroecology, climate change, global warming, organic farming, resistant cultivars

INTRODUCTION

Climate change restricts favourable areas for agriculture, imposes radical changes in farming systems, in crop technologies and animal husbandry, and also in plant and animal genotypes [6]. The effects of climate change are significantly reflected in the air temperature changes and in the rainfall quantity and distribution. Therefore the growth and development of agricultural crops are more and more affected. Among the phenomena abovementioned other evidence of global warming are the melting glaciers and snow, occurrence of extreme meteorological phenomena, raising the level of sea and ocean etc. [9]. Thus, climate change is a major challenge for the agricultural sector, ensuring water resources

and crop stability being the main priorities in the actual context [12]. Current climatic conditions as well as future forecasts indicate that all regions of the world will be affected by global warming [12], [16]. The following question arises: does agriculture contribute to global warming or does climate change affect agriculture? It is critical to know the correct order to be able to act correctly. It seems that intensive agriculture is one of the sectors that generate the largest amount of CO₂ and methane, the main greenhouse gas, one of the most important accelerating factors of the global warming. In a communication from the European Commission on an EU strategy to reduce methane emissions, it was reported that 53% of methane emissions comes from agriculture, 26% from waste and 19% from the energy sector. Methane emissions from

agriculture come mainly from animals especially from the ruminant species due to enteric fermentation (80.7%), from manure management (17.4%) and rice cultivation (1.2%) [3].

The Food and Agriculture Organization (FAO) believes that agroecology can be one of the correct and concrete answers to the challenge of climate change, as this type of agriculture respects the natural balance, reducing human impact as much as possible [5]. In a 1982 publication, the author emphasizes the simplest truth 'agriculture has been ecological since its beginnings' [7]. Therefore, humans must return to it.

The main rules of agroecology include environmental protection, maintaining and increasing soil fertility, respect for consumers' health, recycling materials and resources, maintaining biodiversity, obtaining not maximum, but optimal crop yield, apply of appropriate agrotechnical measures etc. [8]. Also, to reduce the impact of weeds and pests, choosing genetically resistant varieties of crops is an essential condition for the organic farming [2]. A great significance for the realization of this desideratum has the plant breeding science; breeding new genotypes is an efficient way to adapt to environmental conditions and, as a result, to climate change [17]. From this point of view, it can be stated that agroecology is dependent on the plant breeding science in the fight against the challenges of climate change.

Considering the above context, the present paper aims to present the situation of organically grown crops in our country, as well as their evolution over the years, given the importance of how this type of agriculture could slow down the effects of climate change.

MATERIALS AND METHODS

Data presented in this research were accessed from databases and reports of Research Institute of Organic Agriculture, Ministry of Agriculture and Rural Development and National Meteorological Agency and for a higher accuracy were statistically represented

using the program Microsoft Excel, version 2010.

RESULTS AND DISCUSSIONS

This section presents the evolution of the areas cultivated with organic crops in Romania and also the climate changes that our country is going through, considering the close connection between them.

Climate changes in Romania

According to the National Meteorological Agency [13], Romania's climate is temperate-continental of transition, marked by some oceanic, continental, Scandinavian-Baltic, sub-Mediterranean and Pontic climate influences, depending on the latitude and longitude of the areas. Climatic nuances are also manifested on the altitudinal steps, in the mountain massifs of the Carpathian arc being present the cool mountain climate, with high humidity throughout the year. Geographical position of Romania in Europe can be noted in Map 1.



Map 1. Romania on the map of Europe
Source: [15].

In our country, the average multiannual air temperature has increased in 33 years, since 1981 by 0.5°C (Figure 1), but still less than the global average of 0.85°C recorded in the last 100 years [12], [16]. If we report to the coldest and warmest month of the year, January and July, in the last 33 years the temperature has increased more in the coldest month of the year (+1.3°C) than in the warmest one (+0.8°C).

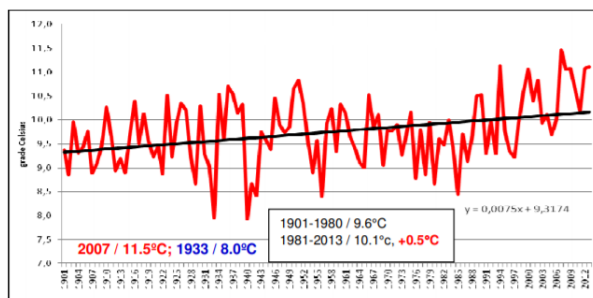


Fig. 1. Average annual air temperature in Romania (1901-2013)
 Source: [12], [16].

Regarding the rainfall regime, there was a decrease in annual quantities from 1901 to 1980 (638.2 mm) compared to the period 1981-2013 (627.0 mm) (Figure 2).

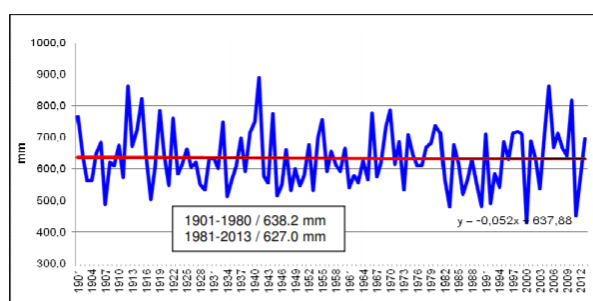


Fig. 2. Average annual rainfall in Romania (1901-2013)
 Source: [12], [16].

Analysing the climatic data recorded so far, can be noted the progressive warming of the weather. Along with this warming, there is an increase of extreme phenomena and also in the alternation between severe drought and heavy rainfall [16]. All these effects of global warming are a dangerous source of stress for the plants; therefore the agricultural crops yield can be severely affected, with dramatic losses.

A climate change scenario for Romania up to 2075 was built based on double carbon dioxide atmospheric concentration [1]. According to the script, the mean of annual temperature for the South of Romania is expected to increase between 3.9°C and 4.4°C with extreme variations in the monthly rainfall regime between -47% and +81% and in their distribution throughout the entire year; it is considered that the most frequent precipitations will fall in autumn and winter, and the lowest in summer.

Besides field crops, global warming also can have negative influence for the livestock sector, on animal health, animal reproduction or productive performance [11]. Climate change involves the reduction of greenhouse gas emissions and adapting ecological systems. In the current situation of climate change, agroecology seems to be indispensable.

Organic agriculture in Romania, European Union and worldwide

In our country, organic agriculture was officially recognized in 2000 by the government emergency ordinance (GEO) no. 34 from April 17 [8]. Even if over the years, this type of agriculture has occupied more or less areas, in the last time there has been an increase in organically grown surfaces from our country. The evolution of Romanian cultivated areas with organic crops can be analysed in Figure 3. Although over the last 10 years, the trend has fluctuated slightly with both decreases and increases, starting with 2017, the evolution follows a positive trend.

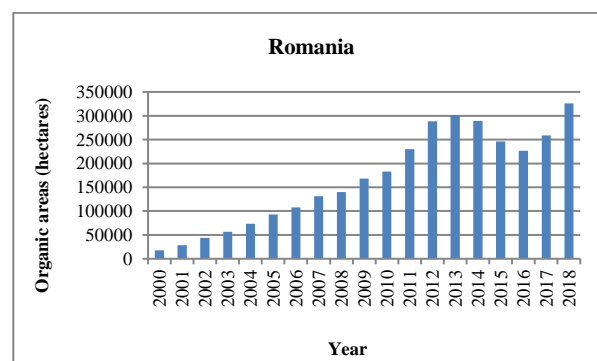


Fig. 3. Evolution of organically cultivated areas in Romania between 2000 and 2018
 Source: Own calculation on the basis of data from FiBL Statistics online data base 2005-2018, Research Institute of Organic Agriculture [14].

As concerns the types of organic crops grown in Romania in 2019 (Figure 4), the largest area is occupied by cereals (32.09%), followed by permanent crops of meadows and hayfields (29.2%), then by industrial crops (19.82%). The smallest ratios of organically cultivated areas are represented by tuberous and root plants, as well as vegetables. The ecologically cultivated species with the largest spread in our country are presented in

Figure 6, where it can be noted the evolution of their areas between 2005 and 2018.

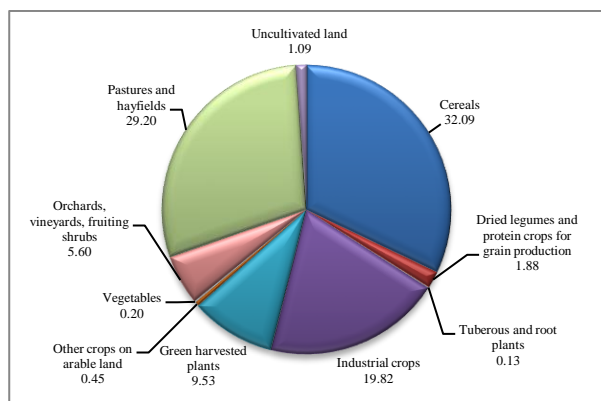


Fig. 4. Percentage distribution of organic crops from the total cultivated area in 2019

Source: Own calculation on the basis of data from MADR report 2010-2019, Dynamics of operators and areas in organic farming [10].

In our country wheat is the most widespread ecological crop, followed by maize, sunflower and barley. Other organic crops but cultivated

on smaller areas, are rye, triticale, oats, rice, soybeans, potatoes and sugar beets [14]. During 2005-2018, the highest spreading of the organic areas was recorded for the maize crop (Table 1).

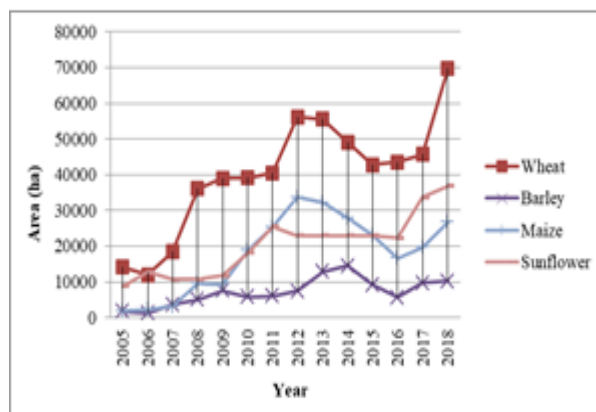


Fig. 5. Organic cultivated areas for the main crops from Romanian agroecological system

Source: Own calculation on the basis of data from FiBL Statistics online data base 2005-2018, Research Institute of Organic Agriculture [14].

Table 1. Progress of ecological crops areas

| Year | Wheat | | Maize | | Sunflower | | Barley | |
|------|----------|-----|----------|-------|-----------|-----|----------|-----|
| | Hectares | % | Hectares | % | Hectares | % | Hectares | % |
| 2005 | 14,095 | 100 | 1,890 | 100 | 8,864 | 100 | 1,750 | 100 |
| 2006 | 11,965 | 85 | 2,217 | 117 | 12,717 | 143 | 1,278 | 73 |
| 2007 | 18,417 | 131 | 3,178 | 168 | 10,704 | 121 | 3,673 | 210 |
| 2008 | 36,137 | 256 | 9,523 | 504 | 10,701 | 121 | 4,982 | 285 |
| 2009 | 38,979 | 277 | 9,364 | 495 | 11,714 | 132 | 7,610 | 435 |
| 2010 | 39,160 | 278 | 18,869 | 998 | 18,161 | 205 | 5,840 | 334 |
| 2011 | 40,529 | 288 | 25,386 | 1,343 | 25,490 | 288 | 5,999 | 343 |
| 2012 | 56,151 | 398 | 33,759 | 1,786 | 22,915 | 259 | 7,469 | 427 |
| 2013 | 55,486 | 394 | 32,199 | 1,704 | 22,910 | 258 | 12,900 | 737 |
| 2014 | 49,060 | 348 | 27,860 | 1,474 | 22,915 | 259 | 14,519 | 830 |
| 2015 | 42,854 | 304 | 23,137 | 1,224 | 22,910 | 258 | 9,215 | 527 |
| 2016 | 43,495 | 309 | 16,643 | 881 | 22,372 | 252 | 5,689 | 325 |
| 2017 | 45,687 | 324 | 19,671 | 1,041 | 33,712 | 380 | 9,670 | 553 |
| 2018 | 69,684 | 494 | 26,745 | 1,415 | 36,870 | 416 | 10,237 | 585 |

Source: Own calculation on the basis of data from FiBL Statistics online data base 2005-2018, Research Institute of Organic Agriculture [14].

Compared to the reference year 2005 the cultivated area has grown by fourteen times. We considered 2005 the reference year because the appearance of pre-accession funds for Romania stimulated the cultivation of the

organic crops. Among maize, also the area cultivated in ecological regime with barley grew almost 6 times, the area cultivated with wheat almost five times, and the area cultivated with sunflower more than 4 times.

In a study developed by some researchers of the National Institute of Meteorology and Hydrology and of the Institute of Geography that aimed inter alia the evolution of wheat and maize crops from our country in the context of the global warming approached scenarios, maize crops from the South of Romania looks like will be the most affected by climate changes compared to wheat [1].

Due to predictions and considering the huge importance of corn for the daily life of humans, but also for animals, special attention must be paid to this crop by creating resistant hybrids to the alternation of climatic factors, and also with a good capacity to adapt to less favourable environmental conditions, suitable for organic cultivation.

When compare the growth trend of organically cultivated areas in our country, with the trend in the European Union (Figure 6A) or even worldwide (Figure 6B), it can be noted the same increase in areas allocated to the organic farming system, which demonstrates its effectiveness if not in stopping, at least in slowing down climate changes.

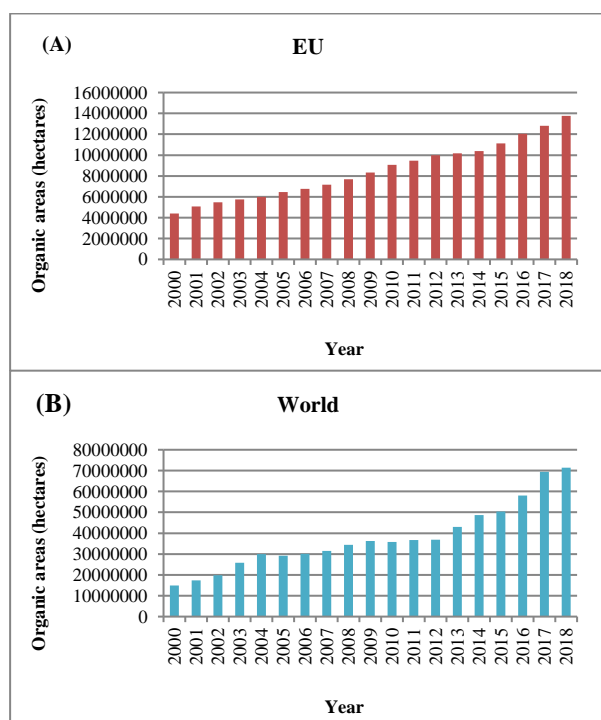


Fig. 6. Evolution of organically cultivated areas between 2000 and 2018 in: (A) European Union; (B) Worldwide

Source: Own calculation on the basis of data from FiBL Statistics online data base 2005-2018, Research Institute of Organic Agriculture [14].

In order to have a real overview of agroecology spread is absolutely necessary to know the percentage of organically cultivated areas out of the total arable areas (Figure 7).

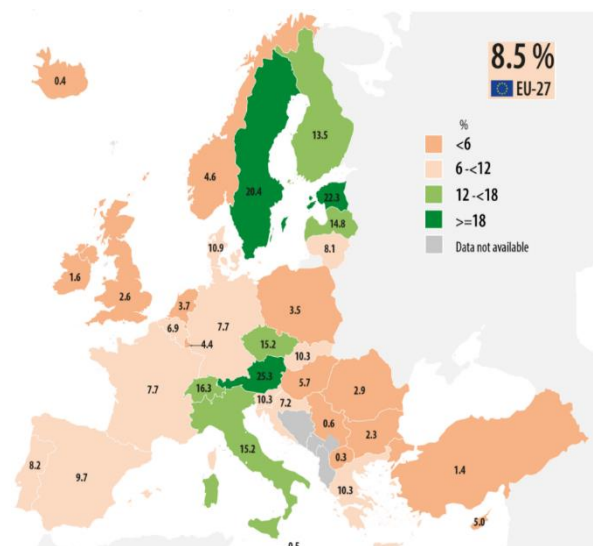


Fig. 7. Agroecology area in European Union (2019) (% of organic area in total utilized agricultural area) Source: [4].

Romania is part of the group of countries with the smallest areas for organic crops (2.9%), but given the upward trend in the evolution of ecological surfaces from the last years, this could improve over time. At the forefront of states that have allocated largest areas for organic crops are Austria (25.3%), Estonia (22.3%) and Sweden (20.4%). Thirteen countries exceed the average of 8.5% organic area from the total EU agricultural land.

According to EUROSTAT the total area of agroecology in the EU continues to increase, and reached to almost 13.8 million hectares of agricultural land in 2019 [4]. The increase of the surfaces on which the agroecology extends corresponds to the necessity of the humanity to return to the natural state, just how agriculture was from its beginnings, in order to slow down the climatic changes.

CONCLUSIONS

In Romania over the analysed years, organic crops have recorded ups and downs but in recent years they have experienced only

upward trends, the organic areas being more and more extensive. Same trend can be noticed in the European Union and worldwide. The largest organic area in our country is occupied by cereals (32.09%), followed by permanent crops of meadows and hayfields (29.2%), then by industrial crops (19.82%). The smallest ratios of organically cultivated areas are represented by tuberous and root plants, as well as vegetables. Wheat is the most widespread ecological crop, followed by maize, sunflower and barley. Other organic crops but cultivated on smaller areas, are rye, triticale, oats, rice, soybeans, potatoes and sugar beets. The highest increase of the organic areas over the years was recorded for the maize crop (1,400%). Even if Romania is part of the group of countries with the smallest areas for organic crops (2.9% from the total agricultural land), given the upward trend in the evolution of ecological surfaces from the last years, this could improve over time. At EU level total area of agroecology reached to almost 13.8 million hectares of agricultural land in 2019 and continues to increase. The extension of organic agriculture on larger and larger areas to the detriment of intensive agriculture is one of the greatest possibilities the humanity has to fight against the climate challenges.

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