STUDY ON THE AREAS ARRANGED FOR IRRIGATION, AS WELL AS THOSE ACTUALLY IRRIGATED, AT THE NATIONAL LEVEL

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Abstract

This paper presents the evolution of the land arranged with irrigation works and of the irrigated agricultural areas, at national level, over a period of 26 years, namely, from 1997 to 2023. The area equipped with irrigation systems was 358,000 hectares in 1944, gradually increasing to 3.2 million hectares by 1989, which represented about 1/5 of the agricultural area and 1/3 of the arable land, with the systems being managed by the state. After 1989, many of the irrigation systems were left in disrepair, the privatization process and the economic transition leading to a dramatic decrease in irrigated areas, dropping to less than 300,000 hectares in the early 2000s. In 1997, the agricultural area equipped was 3,089,065 hectares, which decreased after 20 years to 3,045,177 hectares, resulting in a reduction of 43,888 hectares. However, in recent years, the agricultural area equipped with irrigation systems also recorded a decrease compared to 1997 by 28,473.20 hectares. On the other hand, it has registered an increase compared to 2017 by 15,414.80 ha. The arable land that was irrigated with at least one watering recorded an increase compared to 1997 of 189,609 ha after 10 years, of 83,213 ha after 20 years, and by 300,813.2 ha, compared to the average of the years 2019-2023.

Key words**: **drought, moisture deficit, landscaped land, irrigation, productivity.

INTRODUCTION

Water is the vital factor in maintaining life on earth. Water is also a crucial element in agriculture, having a direct impact on crop productivity, soil health and the sustainability of agricultural ecosystems, helping to preserve the environment and ensure long-term food security. Efficient management of water resources is therefore essential for the future of agriculture and ensuring global food security.

In drought-affected areas, access to irrigation water becomes vital. Efficient irrigation techniques can help farmers survive in adverse climate conditions.

Climate change is a complex global problem, with significant implications for the environment, economy, health and society in general. The frequency and intensity of extreme events (floods, droughts, hurricanes, wildfires) have increased significantly lately (Nițu et al, 2023).

Drought is a phenomenon that can occur in any geographical region and can have a significant impact, even in areas with high average rainfall. In Romania, desertification refers to areas with an aridity index between 0.05-0.65. The causes of drought include both natural factors (low rainfall or lack thereof in the long term) and anthropogenic activities, such as irrational deforestation, inadequate agricultural work and soil erosion, which reduce the capacity of water to infiltrate the soil and store it (Dunăreanu et al, 2023). These problems, combined with the effects of global warming, have led to the expansion of aridization.

In southeastern Romania, it is estimated that about 3 million hectares are potentially affected by desertification, most of them being agricultural land. Over the past two decades, drought has become a common condition, affecting about 14.7 million hectares of agricultural land, of which 64% is arable land. At the level of the whole country, it is estimated that about 2% of the total agricultural area is affected by extremely severe drought (practically every year), 28% is affected by very severe

drought (in over 40 out of 100 years) and 60% by reduced drought (in less than 10 out of 100 years) (MADR, 2007, inmh.ro)
Severe drought occurs in years with rainfall below the multiannual average, and dry cycles extended from 12-15 years to 22 years between 1982 and 2003. Studies show that dry years account for 70-75% of all years, compared to 25-30% for rainy years.
Under these conditions, it is necessary to implement several measures to diminish the disastrous effects caused by the drought, one of these measures being the development of irrigation systems, knowing that these are also in a deep regression compared to 1989, when Romania had managed to cover an area of over 3 million hectares with the possibility of irrigation, and currently the irrigated area is less than one million hectares.
The largest irrigation systems in Romania: The Danube Meadow Irrigation System with an irrigated area of approximately 600,000 ha, the Irrigation System of Ilha Mare of Brăila with an irrigated area of approximately 320,000 ha, the Sadova-Corabia Irrigation System with an irrigated area of approximately 100,000 ha, the Siret-Bărăgan Irrigation System with an irrigated area of approximately 500,000 ha. The irrigation system in the Western Plain (Banat) with an irrigated area of about 50,000 ha.
In Romania, farmers use various types of irrigation systems, adapted according to the needs of the crops and the characteristics of the soil. The choice of a system is influenced by factors such as water availability, type of crop, costs and efficiency of water consumption (Bonea 2020). The most frequently used irrigation systems in our country are: sprinkler irrigation, drip irrigation, furrow irrigation, flood irrigation, channel irrigation, modern subsurface irrigation, pivot systems.

MATERIALS AND METHODS

In order to study the current situation of the land arranged with irrigation works, statistical data provided by the NISS (National Institution of Statistics) of Romania were used and the percentage method was applied, taking into account the total areas arranged with irrigation works, as well as the areas actually irrigated with at least one watering (average for the period 2019-2023).
Data from NALA (National Administration for Land Improvements) and data from NISS were also used to study the dynamics of irrigation works at national level, between 1997-2007, 2017 and the average of 2019-2023, thus resulting in statistics over a period of 26 years.

RESULTS AND DISCUSSIONS

After 1990, the rate of usage of irrigation systems decreased dramatically, the causes being multiple: excessive fragmentation of land, vandalism, low interest of farmers, obsolete institutional and legislative system, high cost of irrigation water, moral and physical wear and tear of equipment and infrastructure, etc. In Romania, the irrigated areas have experienced significant variations over time, influenced by political factors, economic, climatic and technical. The irrigation systems in Romania were owned by the state until 1989, and in the post-communist period they suffered a significant degradation, however, the area arranged with irrigation works did not change significantly (table 1).
Table 1 also shows that the degree of use of irrigation arrangements, i.e. the area actually irrigated annually, registered significant decreases between 1997 and 2007, depending on the climatic conditions, the allocated funds, the interest of the landowners, the way they are arranged and the cost of the services provided.
Thus, from figure 1 it can be seen that, from 1997 to 2004, the area arranged with irrigation works decreased year after year, with small oscillations, and from 2005, it increased reaching close to the value recorded in 1997, and then registered again annual decreases until 2007, but not as evident as in the years prior to 2005.

Table 1 Situation of land developed with irrigation works between 1997-2007, including those actually irrigated and owned by the private sector

Year	Surface arranged with irrigation works (thousand ha)	Irrigated agricultural area		
		Total (thousand ha)	Of which privately owned	
			(thousand ha)	(%) of Surface Agricultural Irigate
1997	3.184	127.8	36.3	28.40
1998	3.096	234.4	46.6	19.88
1999	3.084	85.0	27.6	32.47
2000	3.082	216.1	94.5	43.72
2001	3.081	327.7	159.9	48.79
2002	3.006	488.1	311.9	63.90
2003	3.043	569.1	407.1	71.53
2004	3.001	327.3	245.3	74.94
2005	3.176	45.7	42.0	91.90
2006	3.157	96.2	87.2	90.64
2007	3.155	320.2	300,1	93.72

[1]http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (25.10.2024)

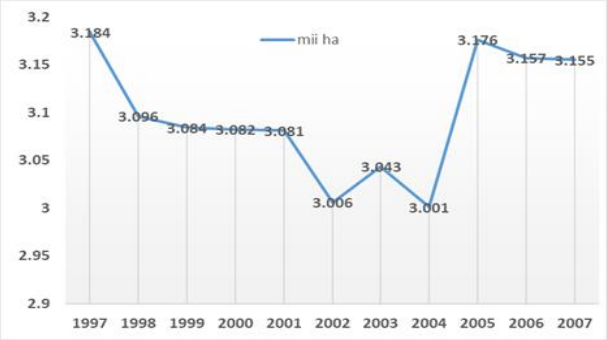


Figure 1. Agricultural area arranged for irrigation between 1997-2007 (thousand ha)

As for the irrigated agricultural area between 1997-2007, from table 1 and figure 2 it can be seen that it increased almost year after year until 2003, said year included, then registered a large decrease in 2005 and 2006 (these years being very good years in terms of rainfall), and in 2007 it reached up to 320,200 ha.

The irrigated area increased from 234.4 thousand ha in 1998 to 569.1 thousand ha in 2003. It follows that in the period 1998-2003, between 12.1-37.2% of the irrigable/rehabilitated area was actually irrigated (at least with one watering). The causes of the reduced use of irrigation systems were varied.

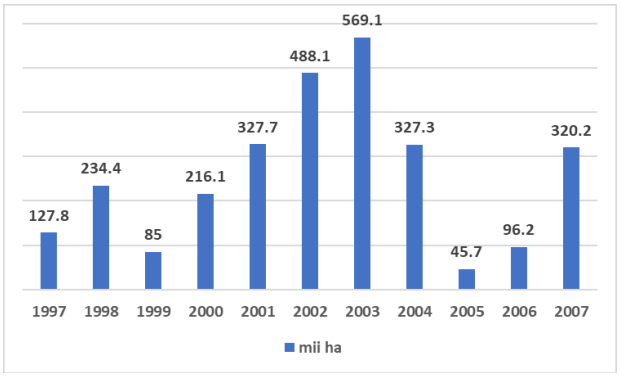


Figure 2. Agricultural irrigated surface between 1997-2007 (thousand ha)

For example, in 2003, only 37.2% of the rehabilitated area was irrigated, which is attributed to the slow pace of establishment of agricultural producers' structures, which did not keep up with the land rehabilitation, the lack of irrigation equipment and the absence of adequate crop structures that would allow irrigation in optimal conditions (small areas dispersed within irrigation water users' organizations). On average, the irrigation systems operated during the analyzed period at a capacity of 25%. (anif.ro).

In 2006, 96,200 ha were actually irrigated (fig. 2), and in 2007, out of the area of 3,155,000 ha arranged, 881,000 ha had economic potential and 320.2 thousand ha were effectively irrigated (anif.ro).

According to statistical data from the 2002 Agricultural Census, irrigation infrastructure is unevenly distributed among the different categories of agricultural producers. The reported irrigable area was 1.5 million ha (representing 10.8% of Romania's agricultural area), of which 532,000 ha (35%) were managed by individual agricultural producers, and 979,000 ha (65%) were managed by entities with legal status. Also, 42% of the total irrigable area was concentrated in 1,295 companies, with an average size of 488 ha, while agricultural companies managed only 16% of the total irrigable area. As for the area irrigated by the private sector, Figure 3 shows that it has registered a continuous increase year after year. More than 2/3 of the total irrigation facilities were owned by the private sector. There were also private local arrangements, of little significance, whose surfaces were

not even centralized, but which were designed in accordance with the legislation in force.

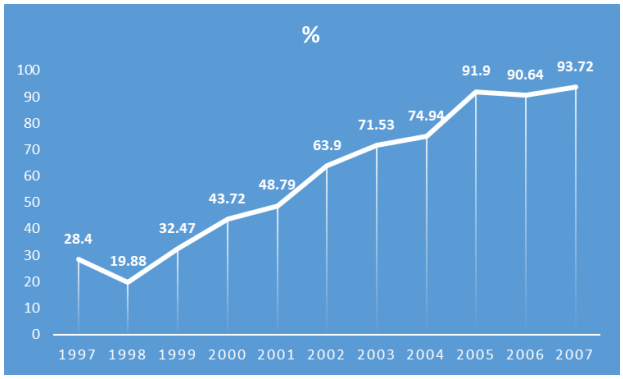


Figure 3. The proportion of irrigated areas managed by the private sector between 1997 and 2007 (%)

Since the large irrigation systems in Romania were designed to serve large farms (between 1,000 and 10,000 ha), their dismantling complicated the efficient functioning of irrigation systems, which came to serve hundreds or even thousands of small owners of agricultural land (with areas between 0.5 and 3 ha).

After 1997, numerous efforts were made to revitalize the irrigation sector, both through subsidies and by restructuring the organization and administration of irrigation systems.

Table 2 shows that at the national level, the total area arranged with irrigation works by categories of land use, (average of the years 2019-2023), was 3,166,218.40 ha, of which the agricultural area 3,060,591.80 ha (96.66%), and the arable land 2,905,508.20 ha, which represents 91.77% of the total managed area and 94.93% of the managed agricultural area.

As for the area actually irrigated with at least one watering, it can be seen that the agricultural area is 429,605.20 ha, which represents only 13.57% of the total managed area. Also, the arable area that is actually irrigated with at least one watering represents 13.49% of the total managed area and 99.30% of the agricultural area irrigated with at least one watering (figure 4).

The large irrigation systems in Romania were developed in the context of organized socialist agriculture, the area of irrigated land increasing considerably, reaching a peak of approximately 3.1 million hectares, the state being the sole owner of the land.

Table 2. Area of land arranged with irrigation works (2019-2023 average)

Crt. No.		Category of land	Surface[1] -ha-	% of total[2]
1	Irrigation arrangements	Total arranged area	3,166,218.40	100.00
		Landscaped agricultural area	3,060,591.80	96.66[3]
		Arable land	2,905,508.20	91.77[3]/94.93[4]
2	Area actually irrigated with at least one watering	Arranged agricultural area	429,605.20	13.57[3]
		Arable land	426,997.20	13.49[3]/99.30[4]

[1] http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (25.10.2024)
[2] own calculations
[3] from the total arranged area
[4] from the arranged agricultural area

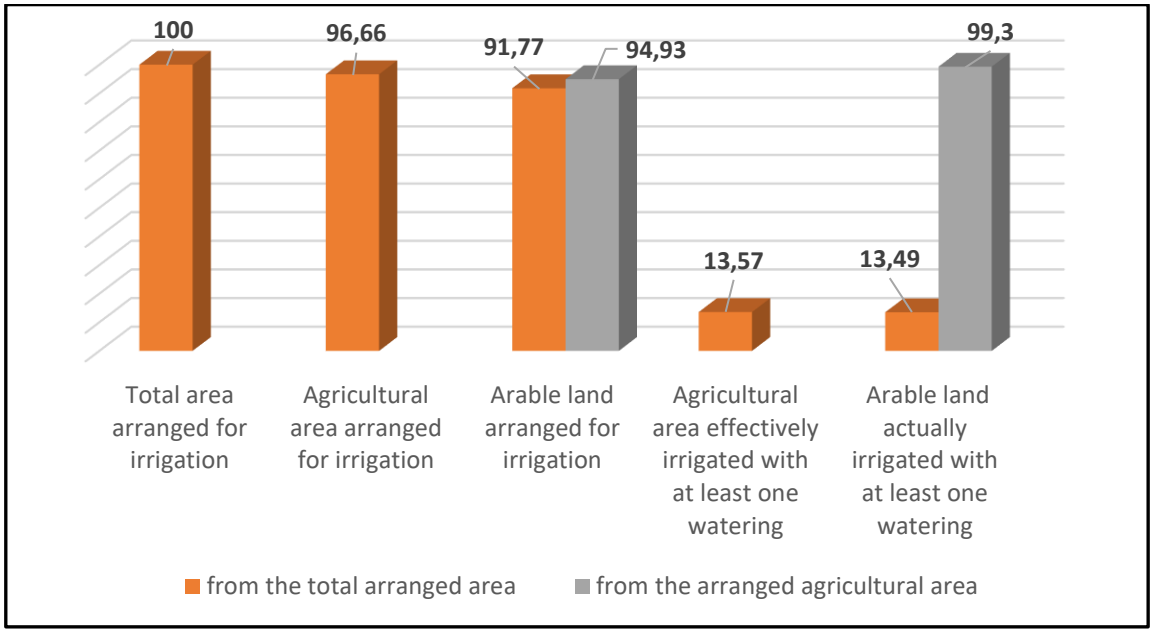


Figure 4. Structure of the land arranged with irrigation works

Table 3 shows the dynamics of the land arranged with irrigation works during the years 1997, 2007, 2017 and the average of the years 2019-2023, i.e., practically over a period of 26 years. Thus, the total area arranged with irrigation works, it can be seen that in 1997 it was 3,184,047 ha, and during the years taken in the study, it decreased by 28,161 ha after 10 years, by 34,936 ha after 20 years and by 17,828.60 ha over 26 years, from which it can be concluded that the largest decrease was recorded in the period 1997-2017 (fig. 5). After 2017, half of the area diminished in the last 20 years has been rebuilt due to the efforts made to rehabilitate and expand these systems, which are of particular importance for agriculture and food security.

Table 3. Dynamics of land arranged with irrigation works at national level (ha)

Crt. No.		Category de teren	Years						
			1997[1]	2007		2017[1]		2019-2023[2]Average	
			Effectively	Effectively	±Δ2007 vs 1997[2]	Effectively	±Δ2017 vs 1997[2]	Effectively	±Δ average 2019-2023 vs 1997[2]
1	Irrigation arrangements	Total arranged area	3,184,047	3,155,886	-28,161	3,149,111	-34,936	3,166,218.40	-17,828.60
		Landscaped agricultural area	3,089,065	3,057,047	-32,018	3,045,177	-43,888	3,060,591.80	-28,473.20
		Arable land	2,914,987	2,901,931	-13,056	2,892,686	-22,301	2,905,508.20	-9,478.80
2	Agricultural area effectively irrigated with at least one watering	Arranged agricultural area	127,790	320,243	+192,453	211,586	+83,796	429,605.20	+301,815.20
		Arable land	126,184	315,793	+189,609	209,397	+83,213	426,997.20	+300,813.20

[1]http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (25.10.2024)

[2]own calculations

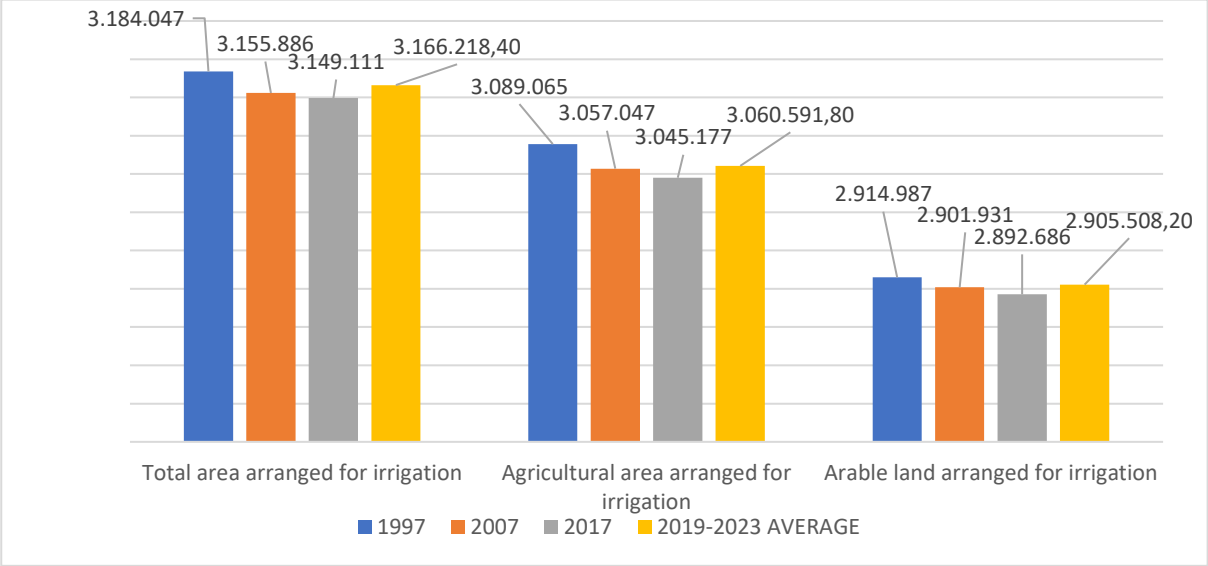
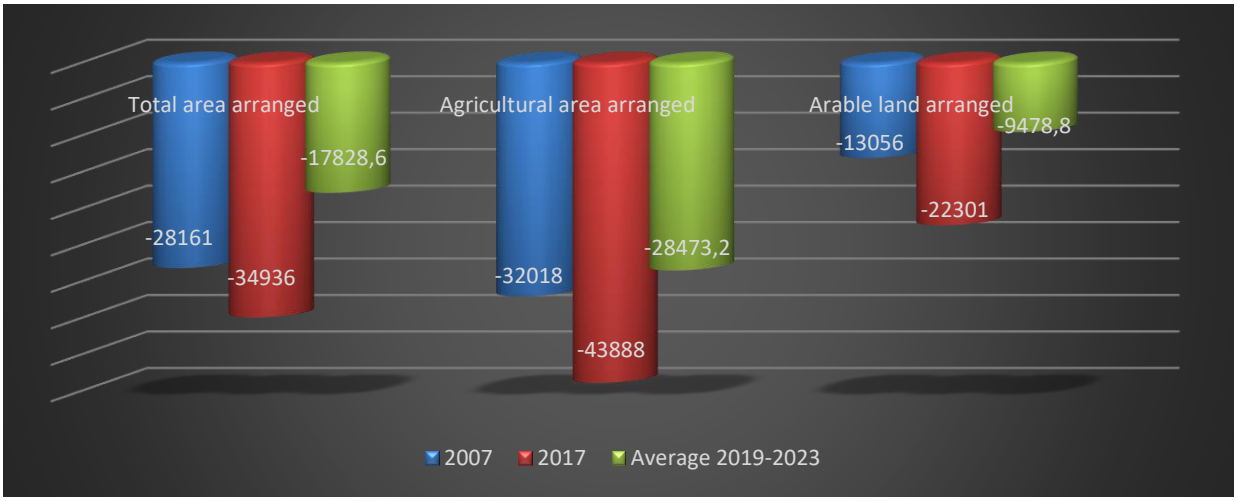


Figure 5. Dynamics of the surfaces arranged with irrigation works

Figure 6. Evolution of areas covered by irrigation works (±Δ compared with 1997)



As regards the evolution of the areas arranged with works to combat the moisture deficit, during the 26 years taken in the study, from table 3 and figure 5 it can be seen that in relation to 1997, the agricultural area decreased by 28,161 ha in 2007, and after 20 years by 34,936 ha. Comparing the year 1997 with the average of the years 2019-2023, it is observed that the area decreased by 17,828.6 ha. The agricultural land arranged with irrigation works decreased by 32,018 ha after 10 years, by 43,888 ha after 20 years and by 28,473.20 ha, compared to the average of 2019-2023. As for the arable land that is arranged with irrigation works, it can be seen that it has also registered a decrease in the area, during the years studied by 13,056 ha after 10 years, and by 22,301 ha after 20 years. Comparing the year 1997 with and with the average of the years 2019-2023, it can be seen that the decrease in the arranged area was by 9,478.80 ha.

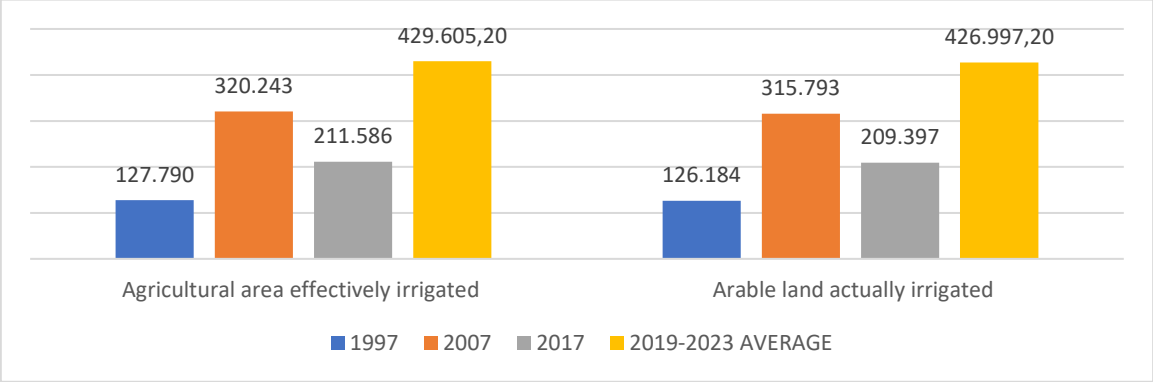


Figure 7. Dynamics of irrigated agricultural areas with at least one watering

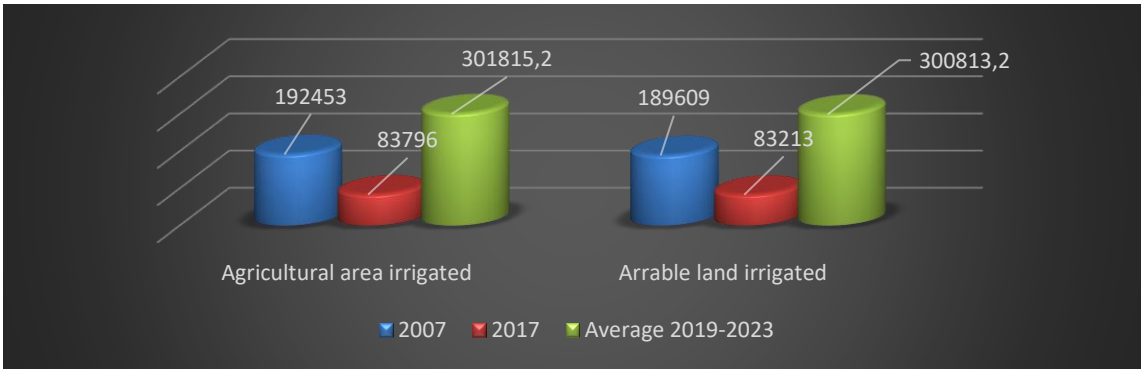


Figure 8. Evolution of irrigated areas (±Δ compared with 1997)

As for the agricultural area irrigated with at least one watering, it increased compared to 1997 by 192,453 ha, after 10 years, by 83,796 ha after 20 years and by 301,815.20 ha compared to the average of 2019-2023. The arable land that was irrigated with at least one watering registered an increase compared to 1997, of 189,609 ha after 10 years, of 83,213 ha after 20 years, and by 300,813.2 ha, compared to the average of the years 2019-2023. Thus, analyzing Figure 8, it can be seen that the areas effectively irrigated have registered positive oscillations during the 26 years taken in the study, and especially in recent years (2019-2023), since on the one hand significant investments have been made for the restoration of irrigation infrastructure, especially through EU-funded rural development programs, and on the other hand, Farmers have become aware that in the current conditions of global warming and the accentuation of atmospheric and pedological drought phenomena, they cannot achieve high and good quality productions without irrigation.

CONCLUSIONS

The irrigated area in Romania is far below its potential, even though the infrastructure could cover over 2 million hectares. Many canals and irrigation equipment are in a state of disrepair, and access to water is limited during drought periods. Inefficient water resource management leads to significant losses and high costs, while the irrigated area varies annually depending on rainfall.

Romania's irrigation systems, built before 1990, cover approximately 22% of the agricultural area and 34% of the arable land. Currently, the area equipped for irrigation is 3.1 million hectares, but only 850,000 hectares are viable, with a growing trend. Recent investments, supported by EU funding, have focused on restoring irrigation infrastructure.

The dynamic of irrigated areas in Romania followed a downward trajectory after 1989, but in recent years important steps have been taken to revitalize the system. However, the current infrastructure cannot yet support the maximum irrigated areas of the communist period. The expansion and

modernization of irrigation systems remain essential for the future of agriculture in Romania, especially in the face of the challenges brought by climate change and frequent droughts.

The transition to a market economy has had important effects on irrigation, in terms of land ownership, institutions, farmers' organizations, irrigation infrastructure, its maintenance and investments. If before 1989 more than 60% of the managed area was irrigated, after 1990, the area actually irrigated decreased sharply to only 20% of the total, in 1992-1993 and reached a minimum of 85,000 ha in 1999, which represents only about 2.8% of the irrigation potential created under the communist regime.

The irrigation system in Romania has considerable potential, but at the moment it is facing various difficulties. Although there are efforts to modernize infrastructure and expand irrigated areas, the pace of progress is slow, and agriculture is increasingly feeling the impact of climate change. To ensure the sustainability of the agricultural sector in the face of drought and climate variability, a long-term strategy is needed, based on significant investments and the adoption of modern technologies.

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