



# Climate Change Impact on Agricultural Production

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**Abstract:** *The purpose of this study is to provide a model with the help of GIS technology to monitor the negative consequences of climate change that occur in Dolj County as a consequence of the aridification phenomenon. The two crops are also presented with the areas occupied by them and the productions obtained over 8 years. The CLC map of the study area provides data on surface occupation. The information can be used to invest in the county's agriculture.*

*An inventory can be made of areas affected by climate change, subjected to significant investments through the planting of protective acacia curtains and irrigation. Surface and production data are available for free download from the National Institute of Statistics for the period 2015-2022.*

## 1. INTRODUCTION

The member states of the European Union have signed and ratified the Paris Agreement. Thus, the European Union commits itself to become the first climate-neutral economy and society by 2025. This represents a long-term environmental protection policy, the European Union undertakes to reduce emissions by at least 55% compared to 1990, by 2030.

In June 2021, the Council of the European Union adopted the European Climate Law, which is part of the European Green Pact. From a legal point of view, the member countries are obliged to achieve their climate objectives for the year 2030, as well as those up to the year 2050.

Romania, as a member of the United Nations, agrees that climate change and the consequences arising from it represent a cause for concern for all nations. Through its activities, industry has increased the concentration of greenhouse gases. This increase in the greenhouse effect will determine in the coming years the increase in the temperature of the earth's surface and the consequences that will be borne by natural ecosystems.

According to the Charter of the United Nations and the principles of international law, countries have their environmental legislation, but they are obliged not to harm the environment of other countries or regions that are not under their national jurisdiction. This reaffirms the principle of state sovereignty, this principle is the basis of international cooperation that is subject to climate change (Ministry of Environment, Waters and Forests, n.d.).

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The UNFCCC (United Nations Framework Convention on Climate Change) objectives established in 1992 are achieving stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic disruption of the climate system; this level will have to be reached in a sufficient time interval, which would allow ecosystems to naturally adapt to climate change so that food production is not threatened. and economic development sustainably takes place.

Within the objectives of the European Ecological Pact, environmental policies and climate change represent the most important political goals. The European Green Deal was published on December 11, 2019, within the European Commission, for environmental protection and climate change policy guidelines. The emblematic objective of the European Green Deal is to transform Europe into the first climate-neutral continent. The document represents a road map leading to the achievement of this objective.

The priorities of the European Green Deal are zero pollution, sustainable management of chemicals, water management, biodiversity, air quality, and better implementation of environmental legislation. In line with the approach presented within the European Green Deal, the European Commission has already presented a series of key documents, one of them being

the new EU Strategy regarding adaptation to climate change and its effects. This strategy defines also the directions that must be followed to face their challenges. And encourages state members to continue progress to boost adaptive capacity, strengthen resilience, and reduce vulnerability to climate change (Ministry of Environment, Waters and Forests, n.d.).

In the last period, a warming of Europe's climate by 1 degree Celsius was observed, this increase is higher than the world average. Due to this increase in southern Europe, periods of drought have become more and more frequent. The extreme temperatures recorded that exceeded any record are a consequence of the climate changes caused by humans.

Romania has a well-defined legislative framework concerning European environmental policies regarding climate change

- Law no. 24/1994 on the ratification of the United Nations Framework Convention on Climate Change, signed at Rio de Janeiro on 5 June 1992;
- Law no. 3/2001 for the ratification of the Kyoto Protocol to the Framework Convention of the United Nations Convention on Climate Change, adopted on 11 December 1997 (Yilmaz, 2010).

## 2. MATERIAL AND METHODS

### 2.1. Study Area

Dolj County covers an area of 7414 km<sup>2</sup>, 3.1% of the Romanian territory, and is the 7<sup>th</sup> largest county in the country. The Danube River crosses the southern part of the county for a distance of 150 km, also forming the border with Bulgaria. Dolj County is located in the south-southwest area of Romania and stretches between 44°00' and 44°30' north latitude and 22°00' and 23°00' east longitude.

According to the data provided by the National Institute of Meteorology and Hydrology. Dolj County is considered the most arid area in Romania and the only European desert (Achim et al., 2012).

Over 100.000 hectares are being aridization, an area known as the "Oltenia Sahara" - a triangle, on the map, between Craiova, Calafat and Corabia. spread over 6% of the surface. And the specialists say that the dunes advance every year by a thousand hectares. The main cause of this rare phenomenon of desertification is the deforestation of the forest curtains, which stop the effects of aridity. But if in 1970 forests covered 12% of the surface of Dolj county, now they occupy only 7%, and the area is decreasing.

The thermal values for the period 1901-2013 were analyzed at 17 meteorological stations with a consecutive string of measurements for over 100 years. The analysis shows that, in Romania, the average annual air temperature has increased in the last 36 years by 0.50 0C compared to the entire analyzed period. The analysis of precipitation shows that, from a pluviometric point of view, there is a trend of decreasing annual amounts of precipitation in the period 1981-2013 compared to the period 1901-1980. In the Oltenia region, the decrease in the average amount of precipitation is evident for the period 1981-2013 (642.0 mm/year), compared to the reference period 1961-1980 (673.4 mm/year) (National Meteorological Administration, n.d.).

How local resources are managed is very important, because the problems of climate change can be amplified and the effect of global warming can be limited. The latest report of the study on climate change highlights that in Romania we will have arid areas that will become even more arid, and those that already have precipitation will have even more precipitation.

From the series of meteorological observations the area most affected by the hydrological drought in Romania in the last decades of the XX century and the beginning of the XXI century, was the south of the country, with excessive aspects for the Oltenia region (National Meteorological Administration, n.d.).

According to the data provided by the National Statistics Institute, agriculture is the second branch of the economy of Dolj County (after industry), with old traditions, within which, after 1991, the private sector developed through the transfer of land from the state property to the property of the former owners. At the end of 2007, agricultural area of Dolj county was 585.223 ha (2<sup>nd</sup> place in the country after Timiș county), of which 488.866 ha were arable land (2<sup>nd</sup> place in the country), 69.275 ha natural pastures, 2.952 ha natural hayfields, 16.841 ha vineyards and wine nurseries (3<sup>rd</sup> place in the country after Vrancea and Galati county) and 7.289 ha of orchards and fruit nurseries.

Dolj County is facing a phenomenon that is hard to control: the south part has a water deficit and is affected by drought. Dolj County ranks first in the country in terms of the percentage of land with a sandy or loamy-sandy texture, with desertification accents.

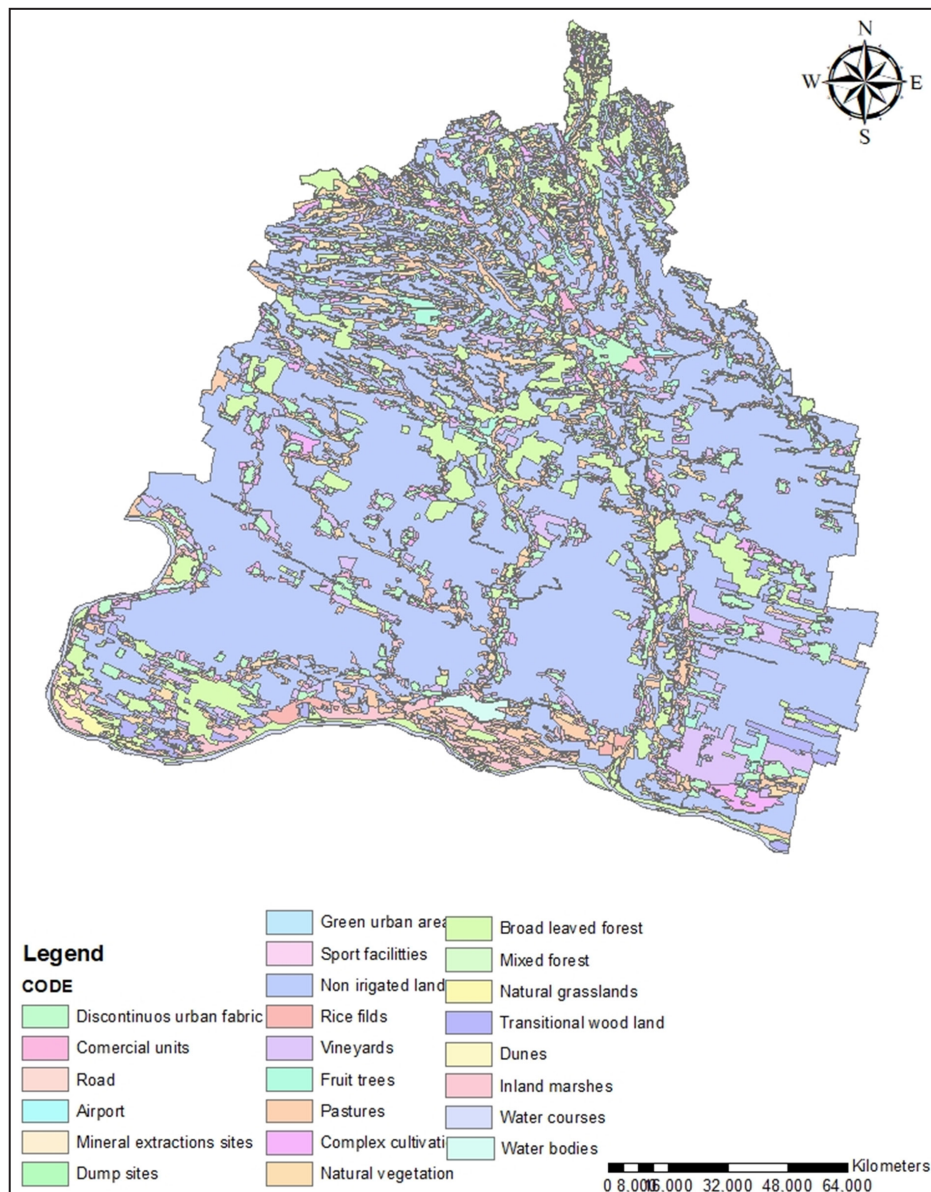
Agriculture is a strongly developed economic branch at the level of Dolj County, standing out for its cereal crops. The development of agriculture was favored by tradition, favorable climate, and fertile soils. However, the agricultural potential of the county is not exploited, the strong fragmentation of the lands, the lack of high-performance equipment, and the lack of support and training of the staff from agriculture have led to the practice of subsistence agriculture, which is unprofitable from the economic point of view. The lack of a broad agricultural system at the county level and the lack of centers for the collection and processing of agricultural products make it impossible for farmers to capitalize on both production at more favorable prices and the real agricultural potential of Dolj County.

Figure 1 shows the Corine Land Cover map of the studied area. This map provides information on how the lands are used. The map was created with the ArcGIS 10.6.1 Program.

Environment Coordination Information (CORINE LAND COVER) is an inventory of land use in Europe, divided into 44 different land use classes. CLC also shows class changes over four periods, starting in 1990. Both land use and changes are mapped at high resolution. The CLC database is made in cooperation with European countries. (Figure 1) (Yilmaz, 2010).

The CORINE LAND COVER program was created by the European Commission to have a Geographical Information System regarding land use in the European Union.

CORINE LAND COVER 2000 (CLC) is a spatial database obtained by photo-interpretation of images provided by Landsat ETM+. Spatial data is being used in the monitoring and evolution of the urban and rural geographical space (Geo-spatial.org., n.d.; Copernicus Land Monitoring Service, n.d.; Open Geospatial Consortium, n.d.).



**Figure 1.** The CORINE LAND COVER map of Dolj County

## 2.2. Cornfield

From the center of origin, Mexico, Central America, and South America, the corn culture, due to the ecological plasticity of the hybrids created, is cultivated around the globe in the most varied climate and soil conditions. In Romania, corn kernels are cultivated on approximately 3.0 -3.5 million ha and 70% of this surface is in the south of the country.

Table 1 and Table 2 show the amount of cereals obtained per ha within the two important crops in Dolj County and the areas occupied by each of these crops.

The studied period is for 8 years. For corn kernels, the largest amount harvested was in 2018, and for sunflower in 2019. The lowest quantities for the two crops are in 2022 and 2015 respectively.

**Table 1.** Average production per hectare, for the main crops

The main crops	Forms of ownership	Year							
		2015	2016	2017	2018	2019	2020	2021	2022
		Kg/ ha							
		Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg
Corn kernels	Total	3471	4025	6856	7779	6332	4806	4485	3914
-	Private sector	3467	4027	6862	7794	6333	4799	4485	3917
-	Individual farms	2977	3681	7197	7220	5683	3423	3539	3334
Sunflower	Total	1659	1697	3027	2765	2946	2045	2831	2039
-	Private sector	1661	1693	3036	2773	2947	2042	2836	2039
-	Individual farms	1558	1435	3757	2902	3363	1472	3361	1925

Source: National Institute of Statistics, n.d.

**Table 2.** Cultivated area with corn kernels and sunflowers, between 2015 /2022 by ownership forms

The main crops	Ownership forms	Year							
		2015	2016	2017	2018	2019	2020	2021	2022
		UM: Ha							
		Ha	Ha	Ha	Ha	Ha	Ha	Ha	Ha
Corn kernels	Total	94208	98409	85294	85006	97165	88872	83335	75754
-	Private sector	93794	97985	85060	84654	97018	88403	83322	75472
-	Individual farms	73696	75091	64902	65384	65963	54855	51832	51839
Sunflower	Total	67560	91007	77329	74132	112769	89937	93151	101297
-	Private sector	66833	90220	76476	73420	112264	89633	91720	99819
-	Individual farms	34300	52490	37937	38124	59453	38453	49195	49332

Source: National Institute of Statistics, n.d.

From the analysis of the data provided by the National Institute of Statistics, it is found that the corn kernels were cultivated in 2022 in an area of 75754 ha compared to 2015 with 94208 ha. In the corn species, a decrease in the cultivated surface is noted. However, agricultural producers are cautious regarding this species, due to the meteorological conditions characterized by low precipitation in recent years and the lack of irrigation systems in certain areas.



The area cultivated with sunflower has positive increases because this species is in demand and very well paid on the market. The area cultivated with sunflowers in 2021 is 93151 ha less compared to 2020. This is because the species needs a rotation of at least 5 years to comply with the conditions of good agricultural practices for the practice of sustainable agriculture against the background of the lack of precipitation recorded in recent years.

### 3. CONCLUSION

1. In Dolj County, the sandy soils represent more than 100,000 hectares, and every year the area undergoing desertification increases by more than 1,000 hectares, a phenomenon due to climate changes and the increase in air temperature. Romania is one of the European Union states most affected by desertification.
2. Dolj County ranks third in the ranking of irrigated areas in Romania, the irrigated area is 70,000 hectares. It is planned that a much larger area will be irrigated in the future.
3. In Dolj County, the main crops are grain corn and sunflower. The area cultivated with grain corn in 2022 was the smallest in the last 8 years. Sunflower had the largest cultivated area in 2022.
4. By applying the irrigation law, in Dolj County, and legislative provisions related to this field, the aspects concerning the transfer of the management of irrigation activities were also addressed.

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