

THE RAPESEED CULTURE EVOLUTION IN ROMANIA IN THE CONTEXT OF CLIMATE CHANGE

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DOI: <https://doi.org/10.31410/eraz.2018.728>

Abstract: *Plant production varies from year to year, being significantly influenced by fluctuations in climate and climate conditions in particular by the extreme weather events. Climatic variability influences all sectors of the economy, but the most vulnerable remains agriculture and the impact on it is more important today. Climate change is more pronounced every year. The complex effects of climate change on agriculture underlie the necessity of the decision-making process on risk reduction in order to maintain adequate harvest standards and to promote sustainable agriculture. Thus, variability and climate change must be addressed through the prism of daily agricultural activities, with the help of mitigation strategies and adaptation measures.*

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The article presents the evolution and the areas of rapeseed culture in Romania. Rapeseed is the plant most widely used in Europe for its energy value. Because climate change has taken place over the last period of time, this agriculture culture is beginning to occupy an important place in oil plant production in Romania.

Key words: *agriculture, climate changes, rapeseed, maps, study area*

1. INTRODUCTION

IPCC (Intergovernmental Panel on Climate Change) was established in 1988 by The World Meteorological Organization (WMO) and by The United Nations Environment Program. The role of the IPCC is to evaluate in an objective and transparent manner the relevant scientific, technical and socio-economic information in order to understand the scientific basis of the climate change risk due by human activity, the potential effects induced by climate change and the options for adaptation and diminution effects. [9]

Climate Change (IPCC) means a statistically significant variation in either the climate average or its variability, which persists for a longer period of time; is due to internal processes, external pressures (forcing) or major anthropogenic changes in the composition of the atmosphere and land use.

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Global atmospheric concentrations of greenhouse gases (mainly carbon dioxide, methane and nitrous oxide) have increased significantly since 1750. The main cause of these increases was human activity, with the effect of global warming.

The period of eleven years - 1995-2006 - are among the warmest years since the global recordings temperature began (1850). The linear warming trend over the last 50 years (0.13°C (0.10°C - 0.16°C) per decade) is almost double that of the last 100 years. The total temperature increase in the period 1850-1899 and in the period 2001-2005 is 0.76°C [0.57°C - 0.95°C].

The year 2007 and 2012 were the most drought-prone with severe effects on agriculture. From 1901 until now there have been 3 or 4 years of extremely dry or extreme rainfall in every decade, the highest number of droughts years (five) being recorded in the decade 2001-2010.

Mankind is heading for the least favorable scenario estimated by the International Panel on Climate Change (IPCC), leading to a significant possibility of overtaking 4°C by the end of this century. In order to limit the global carbon budget which permit heating only with 2°C , the global economy needs to increase decarbonization to 6.2% per year by 2100, which would ensure that virtually the global energy system had zero carbon emissions by the end of the century. [9],

In the context of global warming, the climate regime changes in Romania are modulated by regional conditions.

Romania provides a progressive increase in air temperature average during the XXI century, in all seasons. Increases in temperatures will be more pronounced in the summer and winter season. IPCC estimates indicate that, at least according to global estimates, the climate will warm in this century, and rainfall in the region of which Romania is part will change, so that winters will become more humid and summers dry.

Climate change has a different impact in different sectors of activity, and at different levels, adaptation measures will also vary depending on local parameters.

The meteorological and hydrological negative events such as drought and floods are the manifestations with the most significant impact on the agricultural sector and the cause of significant different crops from one year to another.

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Climate risks such as droughts can last for several weeks or months, affecting the results of all annual agricultural production. In Romania, agriculture is the sector contributing year-on-year to GDP by about 6-7%. The agricultural years 2007 and 2012 have been considered the poorest of Romanian agriculture in the last decade. Production per hectare has fallen by 50%, especially for non-irrigated land.

According to centralized data by the Ministry of Agriculture and Rural Development (2012), the drought in the agricultural year 2011 -2012 caused damages on an area of 5.883.466 ha at national level. The most affected crops were maize, wheat, barley, potatoes, sunflower and rapeseeds. (eg production for rapeseed has fallen by up to 80.2%).[9]

"Although many aspects of climate change are associated with different levels of uncertainty (causes, effects, forecasts, etc.), climate change is unquestionable and requires urgent action. It is therefore imperative for Romania to take appropriate measures to mitigate the impact of climate change on its territory and to protect the population from the negative effects of climate change, " mentioned Government Resolution 529/2013 regarding climate change.

The origin of rapeseed is considered to be from the northern Mediterranean area, but it is cultivated on almost all continents. The first documentary attestation is 4000 years ago, and 2000 – 2.500 years were cultivated in ancient Greece and Rome. [5]

In India, China and Korea were introduced 2000 years ago. It is cultivated since the 13th century in Europe, in the northern Alps, and on a wider scale from the 16th century in the Netherlands. Variety cultivation begins in the 19th century, while the first commercial crop emerges immediately after World War II in Canada. Approximately 35 million hectares of rapeseed are grown around the world, of which almost one third is cultivated in Europe. The total area has increased over the past 10 years by about 10 million hectares, especially in North America, but also in Europe and China. [5]

The chemical composition of rapeseed, depending on variety and vegetation conditions, is characterized by 45-50% lipids, 19-20% crude protein and 17-18% extractive non-azote.

World rapeseed agriculture crop.

In 1998, rapeseed was cultivated on 25 million hectares, with 37% more than 1989 -1991, and 114% over 1979-1981. Sunflower occupies a larger area of 3.7 million hectares. In 1994, rapeseeds was on second position in world oil production, with a 161% increase over 1977. The largest rapeseed areas are found in China - 7 million ha, India 5 million ha, followed by Canada with 3.1 million ha. [10]

The rapeseed agriculture crop situation in the European Union.

In Europe, rapeseed is grown on nearly 4 million ha, with the largest growers being France with 1.2 million ha, Germany with 1 million ha, Poland with 460.000 ha and England with 530.000 ha. The rapeseed area in Europe is in the northern half of the continent, where high yields are produced. The average yield per hectare in Europe is approaching 30q/ha compared to 13q/ha world average.

Evolution of cultivated areas and average production per hectare achieved in Romania is presented in the table 1 [7]. In Romania rapeseed has been cultivated since the century XIX, and in 1913 it occupies over 80.000 ha; between the two world wars (in year1930) cultivated over 77.000 ha; then the surface fell to 14.000 ha in 1950 and 18.000 ha in 1960. Later the

rapeseeds has narrowed even more so that during the 1968-In 1973, this plant disappeared from culture. In recent years it has reintroduced and expanded rapeseeds areas thus occupied 68.000 ha in 2000 and in 2009, 2010 and 2011 a vertiginous growth of surfaces is observed.

Specification	SM	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Surface	10 ³ ha	364,9	365,0	419,9	537,3	392,7	105,3	276,6	406,7	383	471
Average production	Kg/ha	991	1844	1357	1755	1882	1496	2408	2604	2530	2836
Total production	10 ³ tons	361,5	673,0	569,6	943,0	739,0	157,5	666,1	1059,1	959	1336

Table 1: Data on surface and production evolution in Romania [8]

Source: 2007 - 2015 - INS data - Romanian Statistical Yearbook; 2016 - INS data - Plant production in the main crops

MATERIALS AND METHODS

Environmental support of agricultural production

The growth and development of plants, ultimately their production, is determined by the provision of living conditions (ecological support) as close as possible to those of the natural environment in which they were formed. These factors are called ecological because they are directly related to cultivated plants and act on larger or smaller agricultural territories.

Ecological conditions may be direct influences (climate and soil) or indirect (altitude, incline, and field exposure). The influence of ecological conditions, expressed by the natural climate and soil factors, through their relations with cultivated plants, is stronger than in any other branch of material production.

The various ecological conditions, the complexity and the proportionality of the reliefs make Romania a country with a wide diversity of agricultural landscapes, in which numerous plant cultivation systems and methods are applied. The knowledge and differentiation of the ecological conditions on the territory is of major importance in the scientific organization of agricultural production, in its technical and economic foundation at national, zonal and agricultural level. The ecological function of natural factors is essential to establish favorability for the ecosystem in general and for each crop, expressed in production capacity.

Rapeseed is a cultivated plant especially in areas with a temperate continental climate, characterized by winters with higher temperatures and cool and humid summers.

These conditions are fulfilled in the Moldavian Plain, the Moldavian Plateau, the Transylvanian Plateau and the Western Hills. (figure 1) [5],

The rapeseed is grown on deep permeable soils and medium texture with high content of organic matter and calcium. Such soils are; chernozems, cambic chernozems, gray soils and alluvial soils. These types of soils meet in the above-mentioned geographic regions.

In these areas the amount of rainfall is between 450 - 650 mm per year. The rapeseed is being pretentious to water due to the high sweating coefficient. In Table 2 are presented the agricultural areas where the rapeseed is cultivated and the sum of the annual temperatures and the annual amount of rainfall

The following maps presented the most favourable areas for rapeseed crop. Maps used geographic data to extract the elements needed for the analysis and are based on the following datasets.

- Corine Land Cover - European Environment Agency, 2010, Corine Land Cover 2000 seamless vector data - version13 (02/2010), [Available online] URL: <http://www.eea.europa.eu/data-and-maps/data/c12> = Corine land + cover +version + 13. (used to make land use map).
- General vector datasets Romania (2009), [Available online] URL: <http://earth.unibuc.ro/download/romania-seturi-vectoriale>

The maps were made using ArcMap10.1.

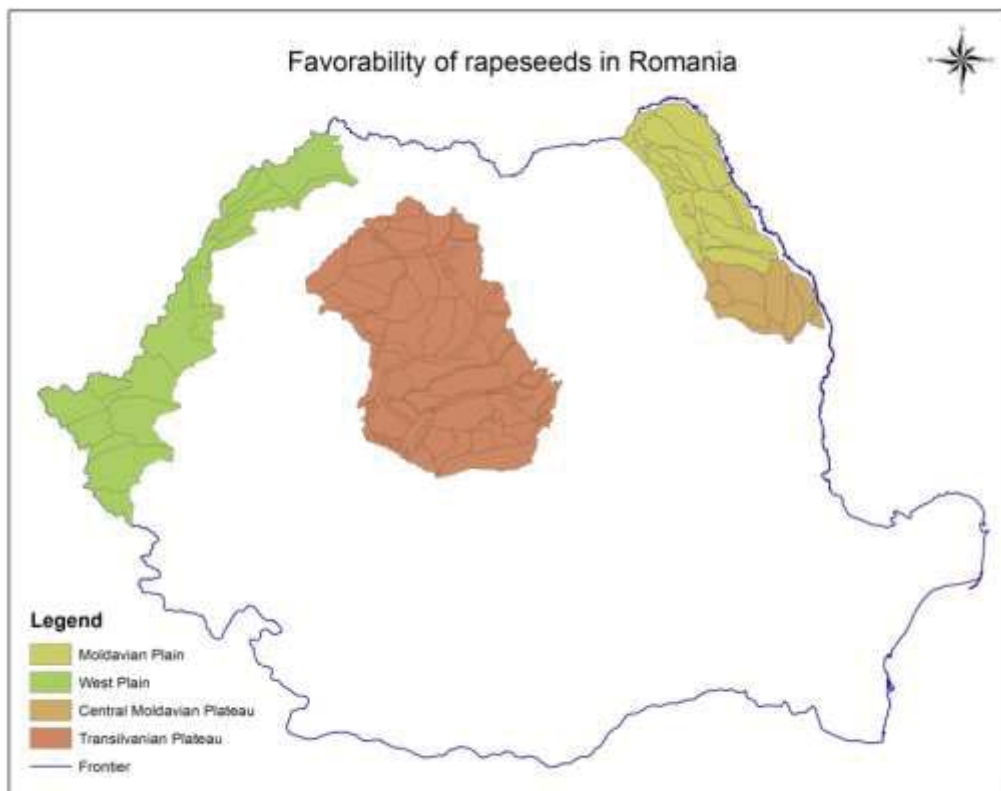


Figure 1 The favourability map of rapeseed in Romania

Land cover is an image reflecting at the same time land use (housing, agriculture, industrial activities, transport, forestry, tourism, nature protection...) and ecosystems (from biomes to species' habitats). It has accordingly a particular role in economic environmental analysis. This role has been enhanced by the development of GIS tools and datasets which allow producing statistics at different scales and then capture the interactions (long trends, hotspots) across landscapes shaped by geography and history. [2]

LAND COVER: is the observed (bio)physical cover on the earth's surface LAND USE: is considered as the arrangements, activities and inputs people undertake in a certain land type to produce, change or maintain it.

The classification system includes 44 distinct classes CLC2000 grouped into three hierarchical levels. Satellite database which led to the realization CLC2000, known as IMAGE2000 was composed of LANDSAT ETM + image type [2]

In the figure 2 is presented the map of CLC2000 for the study area.

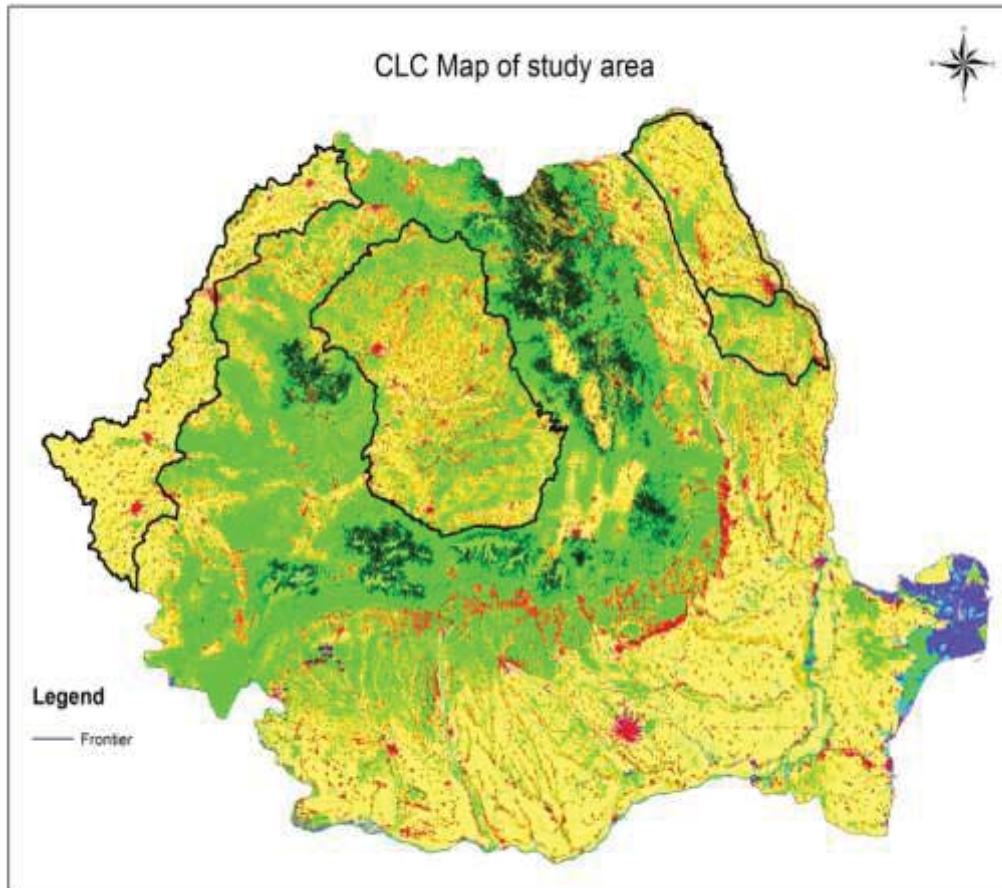


Figure 2 CLC map of study area

Area	Sum of temperature degrees (°C)	Rainfall amount (mm)
1. South area include	3800 - 4200	
1.1 Dobrogea		350 - 400
1.2 Meadow and Danube Delta		450 - 500
1.3 Romanian Plain		550 -650
2. West Plain	3800 -4200	550 - 600
3. Moldova and Transilvania Hills	3200 – 3400 in plain 3400 – 3500 in plateau	450 – 550 in Jijia Plain and Bârladului Plateau 550 – 600 in Transilvaniei Plain
4. West and Est Foothills	2400 – 2800	650 – 800
5. Someșan Plateau	2800 – 3200	600 - 800
Târnavelor Plateau	2800 - 3400	600 - 700
Subcarpathians eastern		600 - 700
Western piemonths		2600 - 3400
6. Curvature hills	T average 9 -11 °C	550 -650

Table 2 Temperatures and precipitation in the main agricultural areas

CONCLUSIONS

1. Romania still has notable results in the country and country ranges for crops and for the production of certain crops, such as sunflower (the first place in the EU) or rapeseed. According to specialists, rapeseed cultivation has developed at a rapid pace in Romania in recent years, the area currently cultivated being the highest recorded in our country since 2010. Romania managed in 2016 to surpass Ukraine in the ranking of the most big rapeseeds producers from the Black Sea, thus entering the ranking of the top 10 producers worldwide. [3]
2. Franz Fischler, European Commissioner for Agriculture 2001-2007, made the following recommendation for Romanian agriculture: Modernization of farms and processing sector "You need investment in human resources, encouraging innovation, supporting modern processing technologies, initiating diversification, improving business start-up conditions for young farmers and increasing the efficiency of the entire food chain. Ensuring participation for farmers in disadvantaged areas and the introduction of risk management are also crucial elements to modernize farms. "
3. Exploiting the agricultural potential by encouraging alternative crops of rapeseed, in order to provide an alternative fuel source for tractors and self-propelled agricultural machines, is a current energy goal with broad development prospects. Growing plants like rapeseed or corn that can later be transformed into fuel is beneficial to the economy and for those who do agriculture on the environment has a beneficial effect given the fact that part of the classically highly toxic fuels environment. [4],
4. Today's agriculture must be seen as a highly technical economic field, subject to unpredictable climate fluctuations generated by climate change with its derivatives - global warming and desertification. At the same time, it should be understood that agriculture is practiced for "existence", and not for "subsistence". Farming of "existence" is bringing production, benefits and profit, and "subsistence" agriculture generates lack of culture, prejudice and loss.
5. Researchers from Utrecht University have shown that in Romania agriculture is framed, the size of agricultural farms is between 1.8 and 3 ha. Almost one million ha of arable land are completely unused. Cultivating a surface area of 10% of the unused area of rape required for biodiesel production would bring important incomes to the national economy and would have a positive influence on environmental protection and pollution reduction. [6]
6. Adopting measures to promote smart agriculture that means:
 - Correctly assessing the agricultural potential from all points of view, starting from:
 - soil,
 - climate,
 - the political and economic environment,
 - the existence of irrigation water,
 - possible climatic accidents,
 - crops and markets,
 - available by labor force, etc.
 - Existing and developing technology solutions for:
 - Performance fertilization,
 - plant health and plant protection measures,
 - measures to reduce abiotic stress, mainly caused by climate change.
 - Decision support systems for certain technological links or for production directions.
7. Large scale production of biofuels requires enormous areas of land for the cultivation of energy crops such as rapeseeds. If the targets put forward by the European Union are

to be met it will be necessary to either reduce the land allocated to other crops or to grow energy crops on land which is not currently used for crop production. [1]

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