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THE INFLUENCE OF METEOROLOGICAL FACTORS ON THE PRODUCTION OF MAIZE CROP IN THE SOUTH-MUNTENIA REGION

BĂDAN DANIELA NICOLETA¹

Abstract: *The impacts of climate change on the area's agricultural potential and their economic and social effects on sustainable development in the environment are a topical and future issue. The paper aims at assessing the potential areas in the South-Muntenia Region, identifying, quantifying and qualitatively analyzing climatic parameters such as precipitation, maximum and minimum air and humidity temperatures, measured during the period 2013-2017 for maize crops for see their influence on productions and deliver optimal solutions. The statistical indicators that characterize the average crop production and the correlation coefficients between them and the main climatic parameters that influence the culture concerned will be calculated.*

Keywords: *climatic factors, average production, parameters*

JEL Classification: *Q1, Q15, Q54*

INTRODUCTION

Corn crop is one of the most important crops worldwide due to its multiple use, being indispensable for human life. This culture has a long tradition in Romania being unpretentious, with low water consumption, because it has a highly developed and profound radicular system with the ability to adapt in conditions of yeast.

Agricultural crop yields fluctuate from one year to the next, being significantly influenced by the variability of climatic conditions and in particular, the occurrence of extreme climatic events.

In the last ten years, the area planted with corms in Romania varied between 2.3 and 2.7 million hectares, except when 2010 was the smallest area of only 2.1 million hectares.

The South-Muntenia Region is the most extensive agricultural land in the country, accounting for almost 18% of Romania's total agricultural area. With 2.33 million hectares of agricultural land, this is the most important area of the country from an agricultural point of view.

MATERIAL AND METHOD

For the purpose of my analysis, I have used data provided by the National Institute of Statistics (NIS), the Ministry of Agriculture and Rural Development (MADR) and data on meteorological factors on the site www.rp5.com, Prognosis and the National Meteorological Administration (INMH).

In order to achieve the proposed objective, data related to meteorological factors such as rainfall and temperatures in relation to the total and average production per hectare were selected, processed and modeled, and correlated with the cultivated areas and total productions in the South-Muntenia Region. At the end of the paper we study the dependence between the total maize production and the climatic factors that influence it, using the simple linear regression statistic-econometric model.

RESULTS AND DISCUSSIONS

At the national level, the areas cultivated with corn recorded a variation in their values throughout the analyzed period, fluctuating from 2402.08 thousand hectares in 2017 to 2605.17 thousand hectares in 2015.

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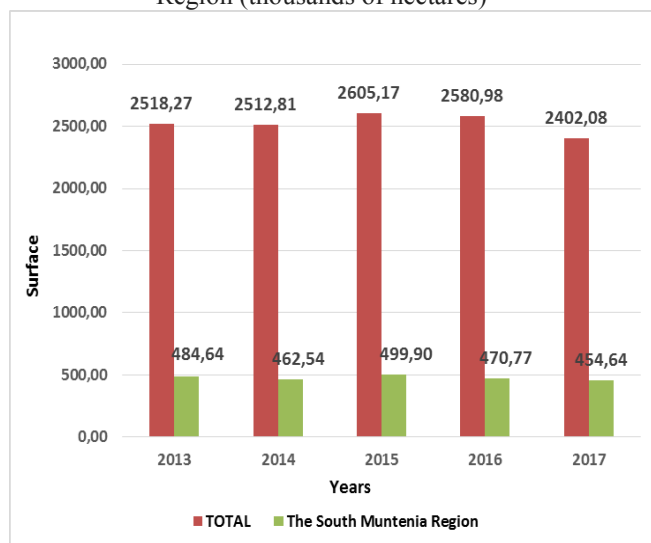
Areas cultivated with maize in the South Muntenia Region account for about 19% of the total national corn surface area.

According to figure 1, it can be noticed that in 2015 the maximum value of the area cultivated with maize in the South-Muntenia Region was 499.90 thousand hectares, 9.95% higher than the last year of analysis, 2017 (454.64 thousand hectares).

As regards to the total production of maize at the national level and South–Muntenia Region, they are inversely proportional to the areas under maize.

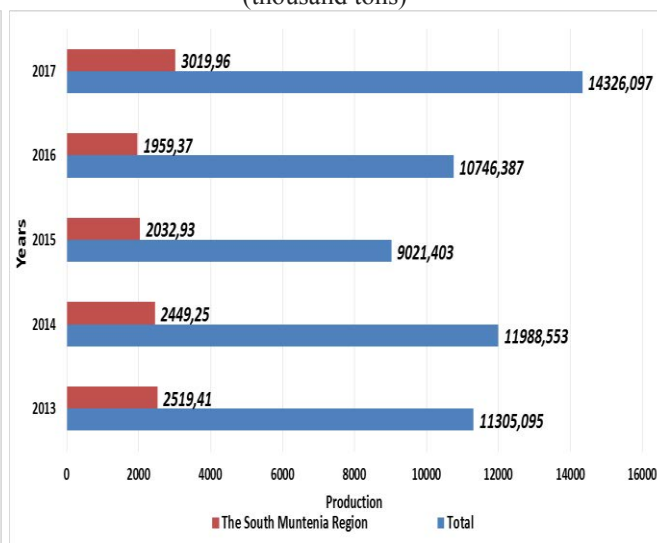
A determinant factor of this situation is the climatic factors, the temperature and the rainfall recorded during the growing period of corn, respectively, from May to August.

Figure no.1 The evolution of the areas cultivated with corn at the national level and by the South-Muntenia Region (thousands of hectares)



Source: INNSE

Figure no.2 Evolution of Total Corn Productions at National Level and South-Muntenia Region (thousand tons)



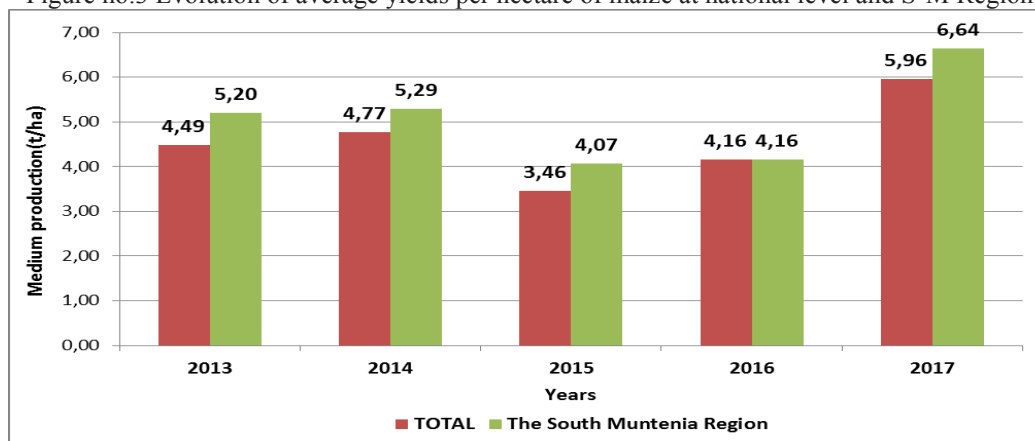
Source: INNSE

The largest national maize production was recorded in 2017, of 14326.1 thousand tons, which is by 37.02% higher than the minimum value recorded during the analyzed period, 2015 (9021.4 thousand tons).

At the South-Muntenia Region, maize production showed an oscillating trend, achieving a minimum production of 1959.37 thousand tons in 2016, which was 35.11% lower than in the last reference year 2017.

The average level of maize production at South-Muntenia region over the analyzed period was 2396.18 thousand tons with an annual growth rate of 4.63%.

Figure no.3 Evolution of average yields per hectare of maize at national level and S-M Region



Source: INNSE

The South-Muntenia Region consists of 7 counties. According to Table no. 1, the Calarasi and Ialomita counties record the highest production at the South-Muntenia Region, with the highest production values registered in 2017 (711.26 thousand tons, respectively 711.30 thousand tons).

The smallest maize production was registered in Argeş and Dâmboviţa counties with values between 161.37 thousand tons and 178.52 thousand tons respectively in 2016.

Table no.1 Total maize production in the counties of Region S-M (thousand tons)

Specifications	2013	2014	2015	2016	2017
The South Muntenia Region	2519,41	2449,25	2032,93	1959,37	3019,96
Arges	247,53	208,20	161,96	161,37	304,32
Calarasi	662,01	616,52	584,34	522,79	711,26
Dambovita	260,86	258,81	184,12	178,52	284,14
Giurgiu	288,59	281,06	213,22	191,25	297,96
Ialomita	537,30	543,09	471,95	432,89	711,30
Prahova	231,19	225,31	185,87	209,23	287,22
Teleorman	291,94	316,26	231,46	263,33	423,77

Source: INSSE

Table no.2 Annual average maize production in South-Muntenia Region (t / ha)

Specifications	2013	2014	2015	2016	2017
The South Muntenia Region	5,20	5,29	4,07	4,16	6,64
Arges	4,51	3,79	3,00	3,02	5,43
Calarasi	6,27	6,48	5,34	5,19	7,72
Dambovita	4,27	4,32	2,98	2,89	4,82
Giurgiu	5,71	5,65	3,80	3,68	6,68
Ialomita	6,11	6,59	5,27	5,72	8,37
Prahova	4,46	4,37	3,42	3,85	5,81
Teleorman	4,01	4,60	3,10	3,62	6,19

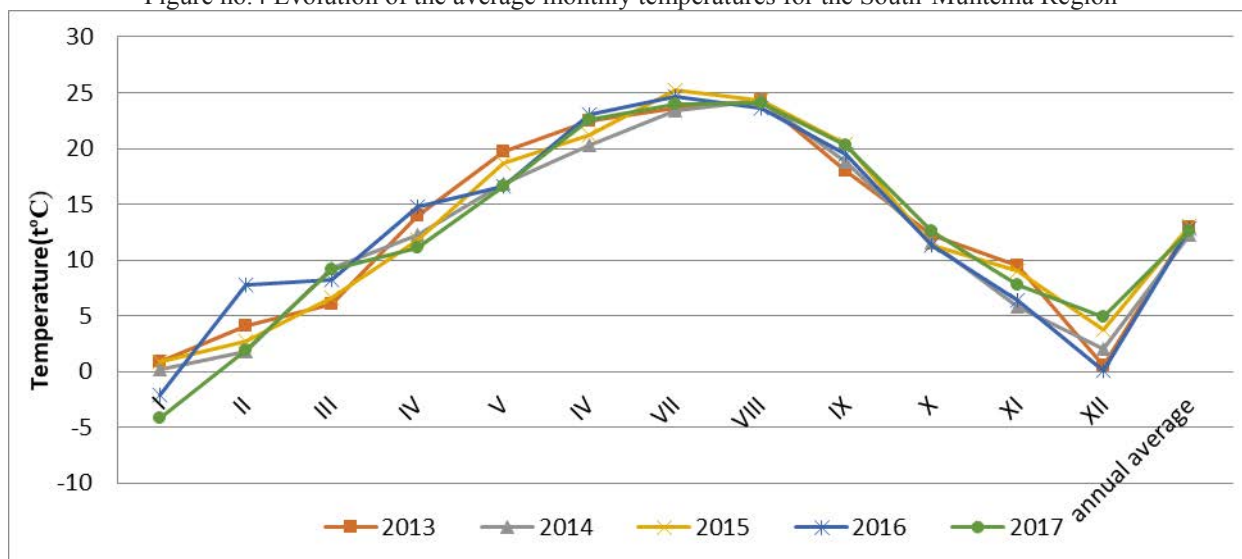
Source: INSSE

Table no.2 shows that at the South-Muntenia Region average annual production of maize followed an oscillating trend in the first two years of the analysis, 2013 and 2014 the production value was 5,20 t / ha respectively 5 , 29 t / ha, then in 2015 it fell sharply by 23.18% over the previous year.

In 2017, the highest annual average production of maize was 6.64 t / ha, 1.5 times the minimum value in 2015. We can say that the climatic factors intervened in the good development of the plant so the final productions were influenced.

From the thermic point of view, in the years 2015 and 2016, from February to September according to Chart no. 4 in the South-Muntenia Region, values were recorded higher than the normal values of these periods. The hottest month of the year was July with the average of monthly temperatures from 23.6 degrees Celsius to 25.7 degrees Celsius; these implicitly affecting the production of maize in this region

Figure no.4 Evolution of the average monthly temperatures for the South-Muntenia Region



Source: own processed data

From the pluviometric point of view, Johannes Humlum has determined that according to the pedo- climatic conditions in Romania, in order for the production per hectare to exceed the average, it is necessary to distribute the amount of rainfall during the entire period of maize

vegetation as follows: in May rainfall is greater than 40 mm, in June and July the rainfall is 60 mm and in August it is 80 mm.

The following precipitation distribution is also considered optimal: May = 60-80 mm; June = 100-120 mm; July = 100-120 mm; August = 20-60 mm.

A fairly logical explanation for the decrease in average and total maize yields for the two owners in the 2015 and 2016 study is the amount of precipitation recorded during the growing season of maize crop.

Analyzing carefully chart no. 5, we can see that:

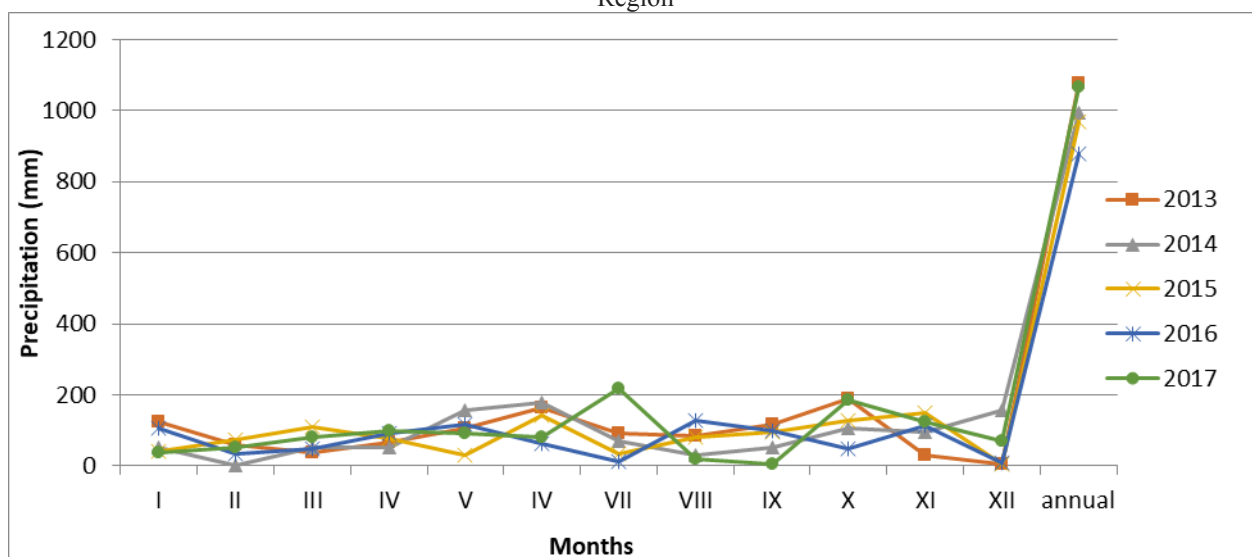
- In May, the precipitation volume reached two extremes; in 2015 the value of the precipitations was below the optimally admitted level, 32.2 mm, being very drought, and in 2016 the value of precipitation was about 2 times the admitted level (117.8 mm), influencing from the beginning of the corn plant development;

- in June 2015, the precipitation rate was too high in 2015 reaching 140.6 mm being 17% higher than the recommended optimum level, and in 2016 the precipitation level was 62.4 below the optimum level between 100-120 mm;

- In July, in both years there was a very low precipitation level of 33.4 mm and 14 mm, respectively, well below the recommended values, about 78.35 lower than the optimum rainfall;

- In August the precipitation level was above the optimum value, with 2016 more rainfall than the optimum 60 mm.

Figure no. 5 Evolution of the monthly rainfall for the South-Muntenia Region



Source: own processed data

Thus, throughout the vegetation period from sowing to harvest in the years 2015 and 2016 extreme rainfall values have been recorded which have negatively influenced the development of the maize plant and led to a decrease of up to 35.1% of the total production of previous years.

In order to establish a simple linear regression model related to the correlation between the annual rainfall and the total maize production for the South-Muntenia Region, I will analyze the evolution of the two variables for the period 2010-2017, using the data series in Table no.3. Thus, the intensity of the link between the two variables can be estimated.

Table no.3 Variables studied

Year	Annual precipitation (mm) *	Total production (thousand tons)
2010	774,30	1794,86
2011	453,10	2381,53
2012	669,70	1388,69
2013	1078,60	2519,41
2014	994,70	2449,25

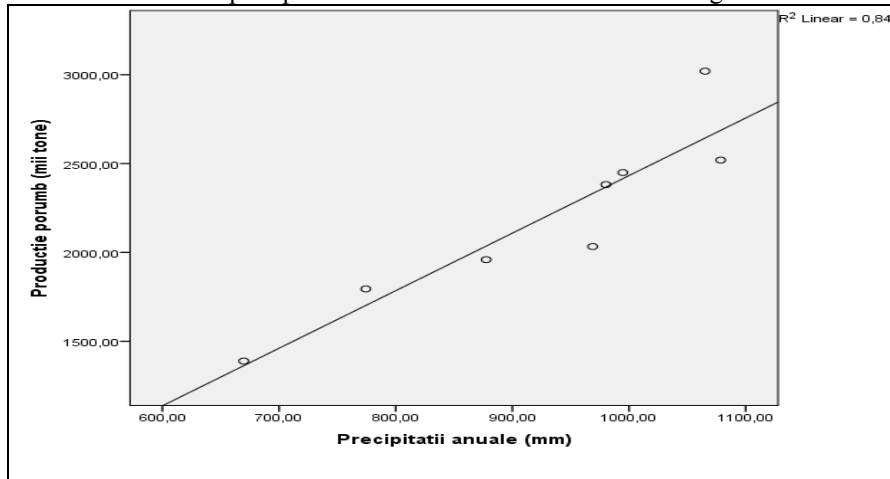
2015	968,80	2032,93
2016	877,50	1959,367
2017	1065,10	3019,96

Source: * according to processed data (NAPP), INSSE

Taking into account the data series in the table above we can see in figure no.6. , that the two indicators under analysis varied in the same sense, so we can state that there is a relationship of dependence between the two variables.

To analyze the typology of the regression model of the two variables, we will proceed to the graphical representation - the Scatter diagram (figure no.6)

Figure no.6. The yield of maize production by annual precipitation variation in South-Muntenia Region



Source: data design (SPSS program)

From the graph above, it can be seen that the graphical representation of the two indicators under study is a straight line. Thus, we can say and appreciate that there is a direct and linear relationship between the two variables, which corresponds to the linear regression model.

Form of simple linear regression: $y = a + bx + \varepsilon$

In the present case, according to the general form of linear linear regression, we obtain the following values of parameters a and b:

$$a = -806,024 \qquad b = 3,239$$

The function that characterizes the analysis in the study is:

$$y = 3,239x + (-806,024)$$

To determine the intensity of the link between the two variables, we found the determination coefficient (R^2). The coefficient shows to what extent the dependent variable is explained by an independent variable; in this case the total maize production, respectively the annual rainfall.

The higher the coefficient of determination (R^2) is closer to 1, the stronger the link between the two variables.

In case of analysis, $R^2 = 0,845$, this has a very close value of 1, indicating that the independent variable (annual rainfall) is explained in a proportion of 84.5% to the dependent variable (total maize production), resulting in a close connection between the two.

CONCLUSIONS

Currently, climate change is recognized as one of the most important and serious environmental, social and economic challenges facing the world. Agriculture is the most exposed

economic sector that can be affected by climate change, being directly dependent on climatic factors.

The South-Muntenia Region holds about 19% of the total cultivated area of maize.

From the data analyzed in the paper it is noted that during the period 2013-2017 the total national maize and South-Muntenia Region are inversely proportional to the areas cultivated with maize.

The largest maize production at national and regional level in the South-Muntenia region was registered in 2017, of 14326.1 thousand tons and 3056.5 thousand tons respectively. In a more detailed analysis at the level of the South-Muntenia region, it is clear that the county counties are Călărași and Ialomița, 711.26 thousand tons, respectively 711.30 thousand tons in 2017. In the years 2015 and 2016 the smallest values of maize production were registered at both national and regional level.

The volume of corn or other crop production is strictly direct and dependent on climatic factors. After analyzing these factors, it was found that in 2015 and 2016 the average temperatures from February to September were higher than the normal values of these periods, which implicitly affected the production of maize in this region.

In the case of precipitation, during the vegetation period from sowing to harvesting in the years 2015 and 2016, extreme values were recorded, influencing negatively the growth of the maize plant and leading to a decrease of up to 35.1% of the total production compared to previous years.

Using the regression model, the direct and linear relationship of the two surveyed indicators, production and annual precipitation at the South-Muntenia region level was demonstrated. The values of the main coefficients being 1, show the correlation of the two variables, thus showing that the chosen model is a valid one, resulting in the dependence and the strong link between the two variables taken in the study.

By analyzing climatic factors such as temperature and precipitation, it has been demonstrated that they directly influence the production of corn. For the yield to be as high as possible, account must be taken of:

- Soil systems (conventional / unconventional / as well as rationalised, with protective coating, balls or no work), these being chosen according to the concrete conditions of each field, thus creating the culture conditions of harmonious development between the conditions soil and climate in that area;

- the sowing season, this being determined by the evolution of climatic conditions; In the dry springs it is recommended to sow at the beginning of the interval, and in the wet it will be sown later;

- the type of seed used in relation to climatic conditions (for example, drought tolerant hybrids may have a productive potential compared to traditional ones).

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