STUDIES ON THE INFLUENCE OF CLIMATE CHANGE IN SUSTAINABLE DEVELOPMENT OF AGRICULTURE OF A REGION

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ABSTRACT

In Romania, the effects of climate change have had and will have a major impact on the evolution of natural conditions, agriculture and biodiversity being the areas most vulnerable to the effects of climate change, given the dependence on climate conditions and the negative environmental, economic and social impacts, Which affects the sustainable development of a region. We can therefore see that sustainable development depends largely on climate change.

This paper summarizes the current state and perspectives on the impact of climate change in agriculture, a synthesis of the state of knowledge of fundamental and applied research methods in identifying the type of extreme meteorological phenomena And the agro-climatic risk aspects of the impact of climate change on agriculture. Mentioning that future projections show that all regions of the world will be adversely affected by climate change, while enhancing regional differentiation in natural resource development and complex effects of extreme phenomena. This synthesis follows the results obtained both at international level and nationally. The Oltenia Region in Romania is no exception to this phenomenon, on the contrary it may be the region most exposed to the desertification phenomen.

INTRODUCTION

Recent research by ANM researchers, which we are grateful for the research made available as well as for the data we later used in the construction of the Seleanynov indices.

The scenarios on the impact of climate change in the Caracal micro-zone on wheat and maize crops have taken into account the models CERES-Wheat (DC Godwin et al., 1989) and CERES-Maize (JT Ritchie et al., 1989). Daily basic biophysical processes occurring at the soil-plant-atmosphere interface in response to the variability of environmental factors.

The impact assessment of climate change on autumn wheat and maize crops was based on climatic scenarios derived from regional climatic models (RegCM) for two distinct periods, namely: 2021-2050 and 2071-2100.

These scenarios predict future climate change by modifying monthly averages of monthly air temperature, rainfall, and solar radiation values that have been applied to the current climate adjustment. The simulated results under conditions of climate change were compared with those simulated under the current climate and the changes in the production levels and the length of the vegetation period were thus quantified.

As a secondary objective, we intend to analyze the evolution of the areas, production and average production during the period 2004 - 2012, at the Caracal micro-zone and the localities of this micro-zone, for wheat, corn and sunflower crops and to see to what extent They were affected by changes in climatic factors. Research on the impact of climate change on sustainable development is achieved through a complex and integrated approach to information in a comparative system of analysis and identification of risk situations in the agricultural field. As far as the impact of climate variability on growth, development and training of agricultural crops is concerned, it is quantified by the potential of meteorological parameters to ensure optimal vegetation conditions or unfavorable effects, depending on the degree of intensity of the disturbing factor, the mode and duration of action, The vulnerability of plant species to extreme weather events. In Oltenia, in general, there were no studies of physiological processes determined under different environmental conditions, respectively water year (2002) and climatic normal (2003), for corn culture "presented in his paper By Pandia Olimpia (2006; 2015). Thus, Barrett (1999) puts the issue of environmental regeneration as an objective and major necessity that arises from the irrational exploitation of resources (which becomes anthropogenic risk, which is a potential risk factor for other risks, with a direct impact on development Durable), a problem that must be thought globally, at the level of spatial and temporal dimensions that satisfy, for at least a long time, the human collectivity.

Sorocovschi (2003) highlights the functional complexity of risks and catastrophes resulting from a large number of factors, components and impacts, reflecting their multidisciplinary and interdisciplinary character. An interesting contribution is the dual risk approach, meaning both the losses and the earnings they produce (Denmead 1960). Another interesting contribution is presented by Berbecel (1980) and Iagăru (2001), which highlights the extent of human risks related to climatic and environmental risks. At present, atmospheric pollution is increasingly "incriminated" by the global climate change, which, if produced, would be the most dangerous natural hazard possible for mankind. In the year (2010; 2013), Sărăcin Ion and his colleagues report "The result of poor agricultural practices regarding the quality of sandy soil in southern Oltenia", due to all the climate changes and the mistakes of applied agricultural technologies.

MATERIAL AND METHOD

The studies and researches were carried out in the Caracal micro-region of Olt, Romania, which includes 8 communes (Brastanovatu, Bucinişu, Deveselu, Obârşia, Redea, Rotunda, Traian and Vlădila) besides the city of Caracal. Agriculture in the localities of this micro zone is well represented, the data presented being eloquent.

The year 2012, reported at the level of Olt county, with a total area of 549,828 ha, the area of the micro-region was about 47,696, or about 9%. A similar share also holds in terms of the agricultural area, Caracal microzone, with about 41,416 ha, accounting for 9.5% of the agricultural area of Olt County. As for the arable land, the Caracal microzone with the 40,532 ha had, at the level of 2012, a share in the county of over 10% of the total arable area.

A first category is represented by qualitative research methods such as: analysis, synthesis, comparison, use of induction and deduction analysis couple, and comparative analysis.

Another set of tools are the quantitative models: statistical processing, accompanied by specific research tools, such as: sorting, structural analysis and dynamics, then statistical and economic analysis, econometric models.

Thus, we have identified the statistical links, links and interdependencies that are formed between different phenomena and processes and the degree of correlation as a method by which we studied the relation and the interdependence between two phenomena or characteristics of a phenomenon expressed numerically.

When increasing the values of a characteristic is accompanied by an increase in the value of the other characteristic, the correlation is direct. When increasing the value of a characteristic corresponds to a decrease in the value of the other characteristic, the correlation is inverse.

We have also identified the degree of functional dependence, that is the correspondence that can be established between two variable sizes, so that, given an arbitrary value of one of the two sizes, it uniquely determines the value of the other magnitude. The two functionally dependent variables can be qualitative or quantitative characteristics.

The most commonly used climate change indicators (temperature, precipitation, and mixed) were selected, among which we chose Seleanynov, which are considered to be representative of our research.

We compute the Seleanynov agro-climatic indices using the formula:

$$SHR = \frac{\sum \text{rainfall}}{0.1x\sum \text{temperature/medium}} \qquad (1)$$

The index is one of seasonality, measuring variations in phenomena in different periods of the year. These are phenomena that normally have seasonal oscillations (temperature and precipitation).

The average index was calculated as the average of the individual indices showing the variation of the same characteristics across the different groups of units.

These were determined for three important crops for the analyzed micro-zone: wheat, maize and sunflower.

We used the calculation of agro-climatic indexes of Seleanynov type in regression functions, which analytically describe the dependence between a resolving characteristic and a factorial characteristic. With this help we synthetically expressed the character and the direction of the connection between the phenomena.

The regression function mirrored the way in which the resolving characteristic changed under the incidence of the change in the factorial characteristic, leaving out the influence of other characteristics considered random and consequently not included in the analysis.

In our analysis, the regression function was a linear one, the resolving characteristic changing evenly under the influence of the change in the factorial characteristic, the linear function we used with the formula:

$$Y = a + b\,x. \qquad (2)$$

Where the values of the resolving characteristic y depend only on the values of the factor x. All other factors are considered constant.

Geometric, the regression coefficient b represents the straight line slope. In the theory of correlation, he shows how large the change of y is, as a result of changing the variable x, by a unit. Therefore, if x increases with a unit, the value of y changes exactly to the size of b.

The regression coefficient b was calculated by applying the smallest squares method.

Between the linear regression coefficient b and the correlation coefficient r was the relation:

$$b = \frac{\sigma y}{\sigma x}\, r \qquad (3)$$

Where σy and σx are the quadratic mean deviations of the y, respectively x, σy and σx concrete characteristics, expressed by a certain unit of measure.

From their report, the linear regression coefficient shows how many units of the variable y return to a unit of the variable x. In our case the coefficient has an inverse correlation.

The correlation coefficient used to determine the correlation intensity was calculated according to the formula:

$r = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{n\sigma x \sigma y}$ (4)

in which:
X - the values of the factorial characteristic;
Y - the values of the resolving characteristic;
Σ x - the average square deviation of the x characteristic;
Σ y - the mean square deviation of the y characteristic;
N - the number of observed values pairs of the x and y characteristics;
or
R = xy - x - y σxσy (5)
in which:
Xy - mean of products xy (xy = xyn)
X and y - the x and y attribute averages.
For the calculation of the correlation coefficient the following formula was used:
R = nxy-x (y) [nx2- (x2)] [ng2- (g) 2] (6)
We then determined the adjustment curve, which was useful, and had to be done taking into account the character of the data to be adjusted. For this, a continuous function, adjustment function, was used with a number of three parameters: temperature, precipitation, production.

The methodology for determining the tendencies and anomalies of the thermal and pluviometric extremes in the Oltenia region aimed to determine and analyze the trends and thermal anomalies of the maximum and minimum monthly temperatures as well as the tendencies of the maximum precipitations within 24 hours in the Oltenia region. For this, we took into account the homogeneous data series for the period 1961-2000 at the meteorological stations in the analyzed region.

Methodology: The monthly average monthly temperature (TXL), monthly minimum temperature (TNL) averages and monthly monthly precipitations in 24 hours (CPT) were determined and analyzed.

The simulation models used to develop climate change scenarios and influence on agricultural crops were those used in NMA research and are CERES (Crop-Environment Resource Synthesis), developed under the auspices of the IBSNAT (International Benchmark Sites Network For Agrotechnology Transfer).

RESULTS AND DISCUSSIONS

Annual fluctuation of climatic factors leads to significant variations in agricultural output from one year to another, and knowledge of the impact of climate variability on vegetation and yields is one of the direct applications of agro-meteorological scientific research in agriculture.

The use of plant protection measures in order to reduce the limiting effect of climatic conditions, especially temperature and precipitation, is clearly reflected in the level and quality of the yields obtained in any area of culture, especially the drought, both irrigated and irrigated.

The analysis of the fluctuation of agro-climatic resources through the dynamic evolution of agro-meteorological/agro-climatic factors is the basic criterion in quantifying the impact of agricultural drought on the state of vegetation and the productivity of agricultural crops.

This way of characterizing and assessing the influence of climate variability on cultivated species/species requires the monitoring of meteorological/climatic factors in terms of evolution of vegetation accumulations (duration and passage of phenological phases) corroborated with agricultural practice, and differentiated cultivation technology differentiated according to specific agropedoclimatic conditions.

The Caracal Plain, which is the area of interest of this paper, is an agricultural area with a generally dry climate, especially the autumn and summer season, the frequency and severity of droughts produced in these seasons being increasing.

In the agrometeorological research activity, the impact studies in the agricultural field are based on meteorological/climatic data from agro-meteorological programs and the archive of climatology (INMH archive), as well as on the basis of specialty, phenology, biometrics and production measurements carried out Both in the standard platforms of meteorological stations and agrometeorological programs, as well as in production fields located near the weather stations.

For the agricultural area of the Caracal Plain, the Caracal Meteorological Station with agrometeorological program is considered representative and meteorological and agrometeorological meteorological and meteorological observations are monitored for a minimum 30-year reference climate according to the WMO guidelines and norms.

Therefore, in order to assess the influence of climate variability on the vegetation state and yields on the main cereal crops in this area, namely autumn wheat and maize, with a significant weight in the structure of the field crops in the south of the country, meteorological data were used And agrometeorological data from 2004-2012.

From the Meteorological Station Caracal and specialized/technological data, respectively average production/ha, from the Caracal Agricultural Research Station and OLT County Department of Agriculture.

Combined action of agro-meteorological parameters of thermal and hydric stress, respectively days with maximum temperatures in air that exceed the biological critical threshold of 32 ° C of wheat plants associated with absent or insufficient rainfall (<10 l/mp/month) determines the significant decrease Of the soil water reserves up to values that characterize the occurrence of pedological drought with varying degrees of intensity, the annual variability and the decrease of crops being in evident correlation with the evolution of the climate (fig.1).

Reference data/figure 1: Extreme/drought-free agricultural years are highlighted:

- 2004-2012:

• the intensity of "heat": VI = 25,3 units of heat;

Precipitations: VI = 34.3 (l/mp;

• Soil water reserve/0-100 cm: VI = 54.8 mm/ha;

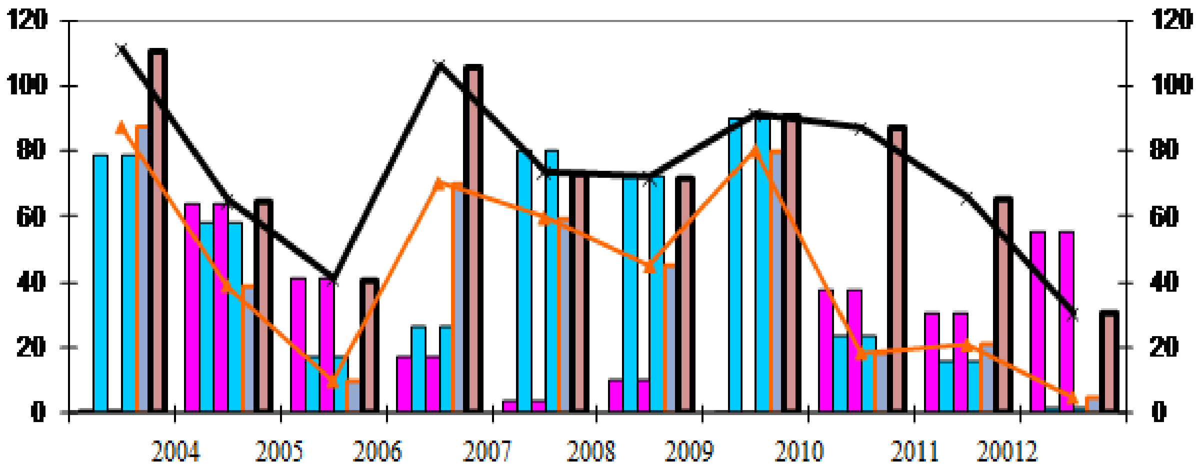
• Medium production: 85: 36.0 q/ha.

*Source: Author

Figure 1. Influence of thermal and hydro stress conditions on wheat yields.

The combined and sustained action of agrometeorological stress and corrosion parameters in maize, respectively, the days with maximum air temperatures exceeding the critical biological threshold associated with insufficient rainfall (<10l/mp/month) caused a significant decrease of the reserves Water from soil to values that characterize the occurrence of pedological drought with varying degrees of intensity, the level of crops thus being in evident correlation with their evolution and duration (figure 2). Reference data/figure 2, which highlights agricultural years of excessive drought:

- 2006:
• the intensity of the "heat": VII = 46.1 units of heat; VIII = 41.2 units of heat
• precipitation: VII = 6.7 l/mp; VIII = 16.8 l/mp;
• soil water reserve/0-100 cm: VII = 25.0 mm/ha; VIII = 10.0 mm/ha;
• average yield/F 376: 40.8 q/ha
- 2012:
• intensity of "heat": VII = 78,4 units of heat; VIII = 55.4 units of heat;
• precipitation: VII = 26.1 l/ mp; VII = 1.3 l/mp;
• soil water reserve/0-100 cm: VII = 10.0 mm/ha; VIII = 5.0 mm/ha;
• average yield/F 376: 30.3 q/ha.



The intensity of the arsh. VIII; PP. VIII (Kmp); Rez WO-100cm(mm/ha); PP. VIII (Kmp); Rez WO-100cm(mm/ha); prod.medie (q/ha)
*Source: Author

Figure 2. Influence of thermal and water stress conditions on maize yields

CONCLUSIONS

The amount of precipitation and its distribution on months and critical vegetation intervals varies from year to year compared to the optimum limits specific to each month, season or agricultural year as a whole, significant negative deviations from them leading to unfavorable conditions for growth and development Plants during vegetation;
The frequency of droughts, giving the agricultural area a dry climate, which requires an increased attention in the choice of autumn wheat varieties, and in the crop technology, the adaptation of the agro-technical measures specific to these conditions, namely the sowing, density, cropping, fertilization, and so on in the period with maximum requirements of maize plants relative to the temperature factor (july-august), the production of the thermal stress quantified by the phenomenon of "heat" varies in intensity and duration, being differentiated from one year to the next, these cases being considered Extreme thermal risk situations with complex consequences on the state of vegetation and the productivity of crop plants;

The combined action of the heat stress factors ("arsita") and hydric (moisture deficiencies) in july-august, with maximum requirements of maize plants relative to the temperature and humidity resources, respectively the intensity and duration of the phenomenon of "heat" , The amount and distribution of precipitation and the degree of water supply of soils is reflected significantly in vegetation and production levels, depending on the extreme characteristics and prevalence of intensity, duration, mode of action and persistence of limiting stress factors, drought-specific indicators agricultural;

The results of the research in the Caracal area can be considered significant for the entire southern area of the Romanian Plain through both the approach of the agricultural drought phenomenon and the adaptation of agricultural measures and practices to the risk situations due to this dangerous phenomenon for agriculture.

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10*CERES (Crop-Environment Resource Synthesis).

11***IBSNAT (International Benchmark Sites Network For Agrotechnology Transfer).***