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ANALYSIS OF THE MAIN CLIMATIC FACTORS AND THEIR IMPACT ON CROP PRODUCTION

Elena COFAS[1], Dana Maria Constantin (Oprea)[2], Iuliana ZAHARIA[1]

[1]University of Agricultural Sciences and Veterinary Medicine, Romania, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40213182564, Fax:+40213182888, Mobile:+ 40 744 6474 10, Email: cofasela@yahoo.com
[2]The University of Bucharest, Faculty of Geography, 1, Nicolae Balcescu Boulevard, District 1, 010041, Bucharest, Romania, Phone: +4021/3143508, Fax: 021/3153074

Corresponding author: cofasela@yahoo.com

Abstract

The data records of crop productivity shows wide fluctuations from one year to another, these being influenced significantly by the conditions climate variability. In general, climate variability affects all sectors of the economy, but, in particular, the agricultural sector it is the most exposed. This study aims an statistical analyze the effects induced by climatological factors on the main agricultural crops, quantified in agroclimatic risks at local and regional levels, for the period 1990-2000, in Ialomita county. Thus, we used statistical data relating to the two groups of variables: 1) agricultural productions (for the main crops – wheat and rye, corn, sunflower, sugar beet, potatoes, vegetables) and 2) climatology data (for the main climatological factors – average temperatures, rainfall, the sunshine duration and the nebulosity) and we analysed the possible correlations for those major variables.

Key words**:** *agriculture, average, climatic, crops, production, temperatures*

INTRODUCTION

Impact of climate phenomena on soils are either direct (due to rising temperatures, changing rainfall volume and intensity and carbon dioxide concentration) or indirectly as a result of changes which bring climate change vegetation or soil biota [5]. Climate change is causing increases erosion of soil's fluid and nutrient leaching, soil structure and texture changes (due to increased tendency of disintegration under the influence of climatic excess), amplifying wind erosion (due to higher summer temperatures and reducing rainfall in summer), reducing the amount and quality of soil organic matter, soil biota biodiversity loss, soil salting etc [6].
In terms of soil, limiting factors of agricultural production are:

- average annual temperature
- average annual rainfall
- gleyzation soil
- soil salinization
- textured Ap (0-20cm)
- groundwater depth
- slightly alkaline soil reaction
- humus reserve stagnant excess moisture (surface). [4]

MATERIALS AND METHODS

Considering the existence of a long line of statistics (both from National Meteorological Agency archives, and field data from meteorological stations and rainfall stations) observations at each station Ialomita is analyzed, from existing documentation and computer sites was used for a comparative analysis and verification of these phenomena correlations.[7] To achieve a climatological study it is envisaged the regime and distribution of meteorological parameter for which requires the application of a scientific method of processing and interpretation of climatological data:

- analyzing the expression in time and space of the weather phenomena;
- determining average characteristics of each analyzed climatic' s parameter;
- compute the average climatic parameters in order to show deviations, that difference method;
- calculate the frequency deviations between different limits;

- analysis of recorded values, averages and extreme analysis, variability in time and space, deviations etc.

RESULTS AND DISCUSSIONS

The effect of climate factors in Ialomita county

Ialomita climate is temperate continental and is characterized by very hot summers and very cold winters with annual thermal amplitude, relatively high daytime and low precipitation from monthly and annual values of key climate elements: temperature, precipitation, cloudiness and sunshine duration.

Temperature: according to records, the average annual temperature is distributed fairly evenly across the county, ranging approximately between 10.5˚C (Armăşeşti) in the north-west and 11˚C in the lowlands adjacent (Feteşti). During the year, the temperature variation is continental, with a minimum in January and a maximum in July (fig.1).

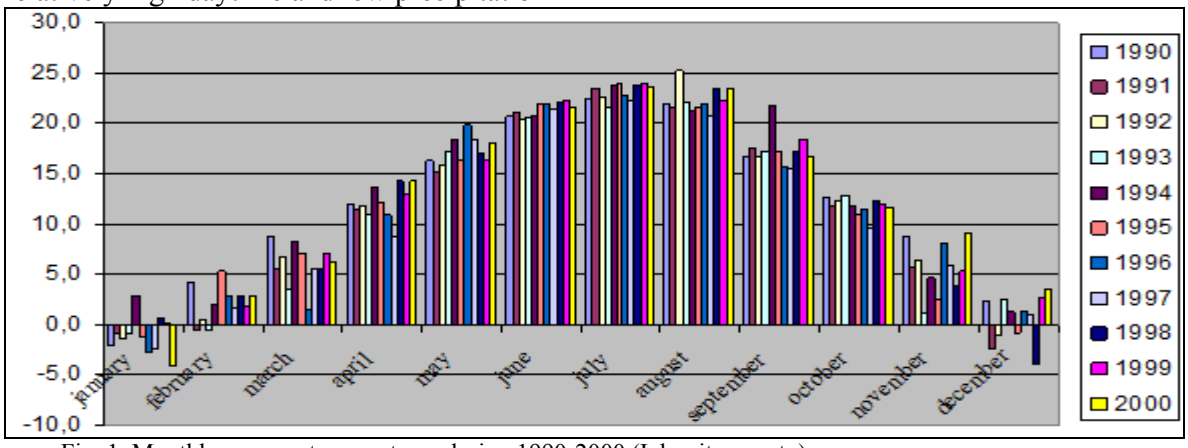

Fig. 1. Monthly average temperatures during 1990-2000 (Ialomita county)
Data source: MARS climate database [10]

In the first half of the year, from February to July temperatures are rising and inter-monthly differences are positive and between 4 and 6°C, due process air heating, high values of radiation balance and the development of thermal convection. From year to year between 1990-2000, temperature values ranged between 9.8 and 14°C. Lowest average annual temperature varied during the same period, between 10 and 11.5°C.

Nebulosity: mean values of cloud in Ialomita, from 1990-2000, varies relatively little.

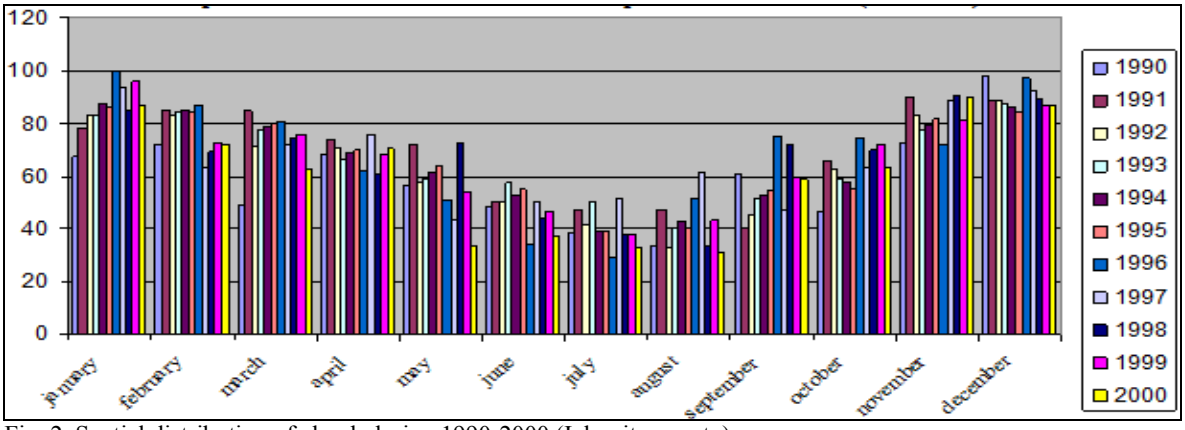

Fig. 2. Spatial distribution of cloud during 1990-2000 (Ialomita county)
Data source: MARS climate database [10]

Evolution of the maximum cloudiness during December-January, influenced the intense activity air circulation and cooling of the lower layers of air in winter, but also increase

of the cyclone activity and persistence of layered clouds and fog, cloud lowest total of the year is found in July-August (fig.2). On cloud frequency is observed as the lowest frequency of days with overcast sky meets the warm period of the year (July to September).

Duration of bright sunshine: this is the amount of time during the day, when the sun shines and is generated by air masses flow conditions. By analyzing the recorded values was obtained as the average annual insolation, as a direct result of the predominance of

continental air is between 2100 and 2200 hours, the annual number of days with clear sky is approximately 110, with 120 cloudy sky and 130 days with overcast sky (fig.3). As a result, this area is a good place to grow vegetables and cereal.

Rainfall: climate influences the amount of rainfall, which - Ialomita - decrease from west to east and from north to south. The average monthly quantities have very different values from one month to another, but generally are low, so the annual average rainfall for the period 1990-2000 is 445 mm/year, but thr trend shows a sharp decrease of the sum of annual values (fig.4).

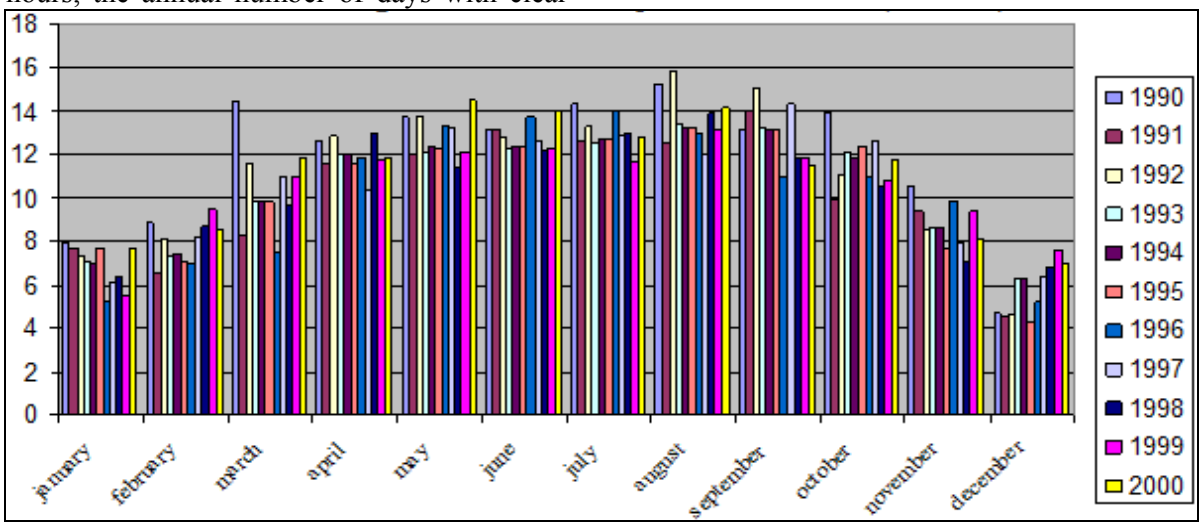

Fig. 3. Duration of bright sunshine durring 1990-2000 (Ialomita county)
Data source: MARS climate database [10]

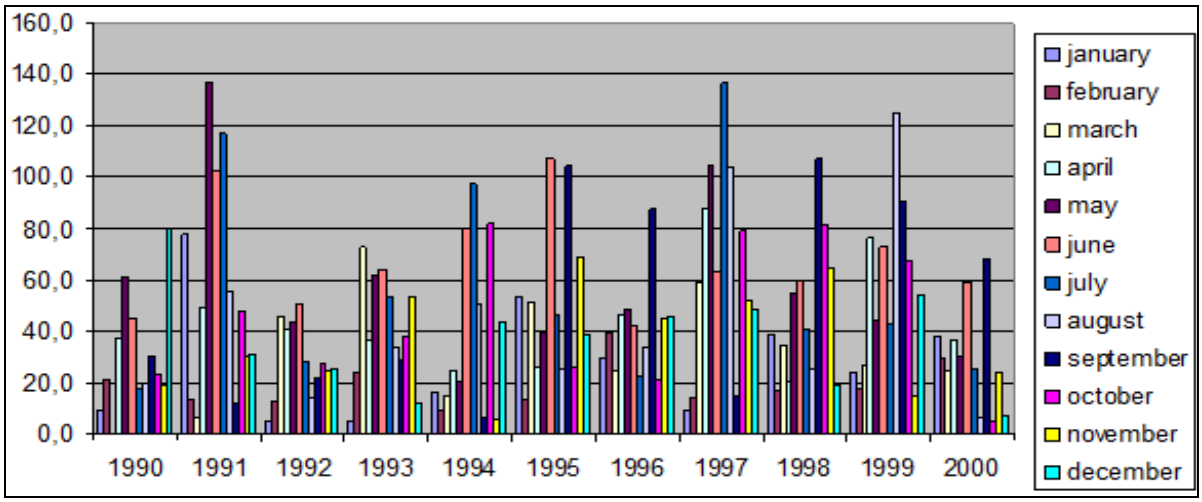

Fig. 4. Spatial distribution of rainfall during 1990-2000 (Ialomita county)
Data source: MARS climate database [10]

Analyze the correlations between climatic factors and production of main crops

The vegetable production sector in Ialomita county presents a great variability in terms of average production, but the climate of this region favors the development of agriculture, because plain profile of this county.[3] Ialomita agriculture is represented by the

leading private sector, as a consequence of the laws of the land, over 331,000 hectares, or 95% of the agricultural area of the county. The region produces annually, on average, almost 900,000 tons of grains, 140,000 tons of technical plants, around 90,000 tonnes of vegetables etc.

Regarding the share of main crops, cereal grains are occupying over two-thirds of the

arable land, followed by technical plants and fodder plants.

Cultivation of cereals prints a characteristic note of the agriculture in this plain county, where wheat and corn continues to occupy the main place in crop production, as this cover the consumption needs of the population.

Cultivation of cereals has a different character, in accordance with the particular conditions of the two large subunits of relief: field and meadow (pond).[8] Thus, in the field the preferred is wheat and forage crops, and in poon areas are found mainly maize, sunflower, alfalfa and vegetables. However, wheat and maize occupies most of the arable land area of the county, followed by sunflower, rapeseed, soybeans, rye.

Table 1. The evolution of agricultural production to the main crops during the period 1990-2000

Crops	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
corn	336432	495513	331473	413803	435519	439069	394684	638014	375725	466025	220498
wheat amd rye	272835	212148	204622	165102	122659	245519	132954	363811	217132	279629	290756
sunflower	46617	44823	67610	65507	73830	79047	79908	68492	78983	101467	69792
vegetables	83126	80303	73882	79230	67008	80595	62547	41703	69102	66009	51417
potatoes	13318	7485	9219	15026	10589	11284	5668	8802	6966	8308	5683
sugar beet	179807	351513	215964	188663	180556	149871	175943	101944	112967	3454	-

Data source: www.insse.ro, Tempo-online [9]

Table 2. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	average temperatures & corn	11	-.522	.100
Pair 2	rainfall & corn	11	.885	.000
Pair 3	sunshine & corn	11	-.509	.110
Pair 4	nebulosity & corn	11	.685	.020
Pair 5	average temperatures & wheat and rye	11	-.068	.842
Pair 6	rainfall& wheat and rye	11	.377	.254
Pair 7	sunshine & wheat and rye	11	.340	.306
Pair 8	nebulosity & wheat and rye	11	-.331	.320
Pair 9	average temperatures & sun flower	11	.297	.376
Pair 10	rainfall & sun flower	11	.204	.547
Pair 11	sunshine & sun flower	11	-.380	.249
Pair 12	nebulosity & sun flower	11	.274	.415
Pair 13	average temperatures & vegetables	11	-.033	.923
Pair 14	rainfall& vegetables	11	-.252	.454
Pair 15	sunshine & vegetables	11	.082	.810
Pair 16	nebulosity & vegetables	11	-.027	.937
Pair 17	average temperatures & potatoes	11	-.110	.748
Pair 18	rainfall & potatoes	11	-.157	.646
Pair 19	sunshine & potatoes	11	.319	.339
Pair 20	nebulosity & potatoes	11	-.214	.528
Pair 21	average temperatures & sugar beet	10	-.363	.302
Pair 22	rainfall & sugar beet	10	-.226	.530
Pair 23	sunshine & sugar beet	10	-.031	.933
Pair 24	nebulosity & sugar beet	10	.099	.785

Table 2 contains Pearson correlation test (own calculation, developed by the authors), measuring the degree of Association for each of the pairs of variables analysed:

1. *climatic factors* (average temperatures, rainfall, duration of bright sunshine, nebulosity);
2. *agricultural productions of major crops* (wheat and rye, corn, sunflower, potatoes, vegetables, sugar beet).

In this context, it was calculated Pearson's coefficients for correlation between all the components of the two groups of variables, as well as significance tests (*sig*) of these coefficients. Basically, the analysis refers to the degree and the sense of simultaneous values' variation of the variable relative to the other variables, using a linear model type (N represents the total number analyzed variables).[2]

Evaluation of the intensity of linear association between each of the two variables is legitimate in this context, but offers a information different than the difference test between average (*t test*).[1]

Thus, table 3 shows the test "t" results, which permits evaluation of the significance of a certain characteristic changes in the same variable in two different situations and is used to examine the effects of independent variables on one or more dependent variables, are calculated also mean, standard deviation

and standard error for each of the two groups of variables.

Table 3. Paired Samples Test

From the analysis of calculated values, it can be seen that the reported amount is not very high, and the level of significance is not very deep (the usual comparison level is .05 or .01), what we suggest that presumption of homogeneity variant has been not breached, more precisely as the climatic factors approximately group is equal to the group represented by the main crop productions (homogeneity variant).

		Paired Differences					t	df
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
					Lower	Upper		
Pair 1	**average temperatures - corn**	-413329.7977273	106174.0901433	32012.6926784	-484658.5220408	-342001.0734138	-12.911	10
Pair 2	**rainfall - corn**	-413297.7848485	106163.1225285	32009.3858181	-484619.1410181	-341976.4286789	-12.912	10
Pair 3	**sunshine- corn**	-413330.6606061	106174.0065658	32012.6674789	-484659.3287714	-342001.9924407	-12.911	10
Pair 4	**nebulosity - corn**	-413276.1537879	106171.7447631	32011.9855197	-484603.3024535	-341949.0051222	-12.910	10
Pair 5	**average temperatures - wheat and rye**	-227912.7068182	72365.8406207	21819.1219070	-276528.7400555	-179296.6735809	-10.446	10
Pair 6	**rainfall - wheat and rye**	-227880.6939394	72361.2778599	21817.7461829	-276493.6618723	-179267.7260065	-10.445	10
Pair 7	**sunshine- wheat and rye**	-227913.5696970	72365.6199488	21819.0553720	-276529.4546849	-179297.6847090	-10.446	10
Pair 8	**nebulosity - wheat and rye**	-227859.0628788	72366.7616623	21819.3996115	-276475.7148803	-179242.4108773	-10.443	10
Pair 9	**average temperatures - sun flower**	-70540.7977273	15719.4032738	4739.5784170	-81101.2365403	-59980.3589143	-14.883	10
Pair 10	**rainfall - sun flower**	-70508.7848485	15717.1577985	4738.9013808	-81067.7151307	-59949.8545663	-14.879	10
Pair 11	**sunshine- sun flower**	-70541.6606061	15719.7962762	4739.6969117	-81102.3634417	-59980.9577704	-14.883	10
Pair 12	**nebulosity - sun flower**	-70487.1537879	15718.8001634	4739.3965724	-81047.1874258	-59927.1201499	-14.873	10
Pair 13	**average temperatures - vegetables**	-68617.7068182	13029.1223572	3928.4282006	-77370.7903192	-59864.6233172	-17.467	10
Pair 14	**rainfall - vegetables**	-68585.6939394	13032.1319095	3929.3356148	-77340.7992851	-59830.5885936	-17.455	10
Pair 15	**sunshine- vegetables**	-68618.5696970	13029.0578513	3928.4087513	-77371.6098623	-59865.5295317	-17.467	10
Pair 16	**nebulosity - vegetables**	-68564.0628788	13029.1796760	3928.4454828	-77317.1848870	-59810.9408706	-17.453	10
Pair 17	**average temperatures - potatoes**	-9292.7977273	3013.1026755	908.4846390	-11317.0276479	-7268.5678066	-10.229	10
Pair 18	**rainfall - potatoes**	-9260.7848485	3014.9319285	909.0361796	-11286.2436780	-7235.3260189	-10.187	10
Pair 19	**sunshine- potatoes**	-9293.6606061	3012.8651524	908.4130231	-11317.7309566	-7269.5902556	-10.231	10
Pair 20	**nebulosity - potatoes**	-9239.1537879	3013.6559757	908.6514653	-11263.7554207	-7214.5521551	-10.168	10
Pair 21	**average temperatures - sugar beet**	-166056.7066667	89146.4527904	28190.5836142	-229828.2373130	-102285.1760203	-5.891	9
Pair 22	**rainfall - sugar beet**	-166023.2100000	89148.8464224	28191.3405471	-229796.4529476	-102249.9670524	-5.889	9
Pair 23	**sunshine- sugar beet**	-166057.5425000	89146.2318731	28190.5137540	-229828.9151117	-102286.1698883	-5.891	9
Pair 24	**nebulosity - sugar beet**	-166002.4991667	89145.9621177	28190.4284499	-229773.6788070	-102231.3195264	-5.889	9

Data source: own calculation on the basis of data from www.insse.ro, Tempo-online , developed by the authors

CONCLUSIONS

Analyzing the influence of climate on agricultural production in Ialomita County, we
may conclude that the importance of climatic parameters, climate characteristics and clime resultant over a long period of time. The results did not suggest good correlation between all climatic factors and all crops analyzed, but there should not be neglected others factors that contribute to increasing agricultural productivity.

Thus, of particular importance to raise the production potential of the soil resources of the county Ialomiţa are land improvement works floodplain soils affected by excess moisture, erosion and salinization or compensation arrangement works for water deficit (irrigation).

Also, by doing agricultural works in time and of good quality by using fertilizers, amendments and pesticides by conducting land reclamation (irrigation, drainage and soil erosion), by improving technology and culture through permanent change in the structure and crop rotation agricultural soil productivity increases providing growing crops.

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