Aspects of climatic factors and the need of irrigation. Case study – Brăila county

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ASPECTS OF CLIMATIC FACTORS AND THE NEED OF IRRIGATION. CASE STUDY – BRĂILA COUNTY

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Abstract: *Climate describes the temperature, precipitation and other weather condition. Climate modification by the progressive warming of the atmosphere resulting from the concerted action of several factors, both natural and anthropic favours the diminution of precipitations at soil level, corroborated with the increase of temperatures. The climate became a constraining factor in the growth and development of crops, its influence being pregnant both in the allocation and use of water resources in agriculture. The phenomena of dryness and drought represent a natural aspect of the continental climate that manifest in the South-East part of Romania. The present study refers to the influence of weather factors and the need of irrigation in the county Brăila.*

Key words: *climatic factors, soil, water resources, irrigations*

INTRODUCTION

Irrigation is one of the important agro-technical measures that contribute to crop production prosperity, to higher yields and maximum profits.

The performant, competitive agriculture cannot be practiced in the absence of this production factor.

Among the factors that influence the need of crop irrigation an essential role is played by the climatic factors (temperature, rainfall, solar radiation, wind intensity) and soil.

MATERIAL AND METHOD

The study was based on methods specific to selective research: identification of problem under research, delimitation of research framework, information collection, data processing, analysis and interpretation and drawing up the conclusions. The method used in this analysis is the aridity index by Em de Martonne**.**

The information sources that have been used are the official data and the data obtained from field surveys conducted under a research project. [2]

RESULTS AND DISCUSSIONS

1. Geographical and climate data

The county Braila is located in the plain, in the south-eastern part of Romania, occupying a part of the lower Siret river plain, a part of the Baraganului Plain and small parts from the plain Salcioara and Buzăului Plain.

The county Braila has a continental temperate climate, at contact with the specific climate of the Danube river plain. Summers are hot and dry, and winters are cold with little snow. The rainfall features high variability in time and space, reflecting the continental climate type.

Moisture deficit mainly depends on air temperature, solar radiation and wind intensity.

The county Braila has average temperatures higher by 1.5^0C compared to the rest of the Romanian Plain. The average annual air temperature in the period 2006-2012 had values over the annual average of the period 1975-2000, the highest values being found in the year 2007.

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[2] FP-7 Project - Sustainable Irrigation Water Management and River - Basin Governance: Implementing User-Driven Services, (SIRIUS), 2010-2013

Tab. 1

Average annual air temperature (ºC) in the period 2006-2012
and average multi-annual temperature (ºC) in the period 1975 – 2000

County	1975-2000 average	2006	2007	2008	2009	2010	2011	2012
Braila	10.7	11.2	12.5	12.1	12.0	11.6	11.3	11.2

Source: *Rapoarte privind calitatea factorilor de mediu in judetul Braila, 2010-2012,* Agenţia pentru Protecţia Mediului Braila

The maximum annual air temperature (41.1^{0}C) was in the year 2007 in the month of August and de minimum air temperature (-22.6^{0}C) was in the year 2010 in the month of January.

Tab. 2

Maximum and minimum annual air temperature (ºC)
in the period 2006–2012 and their dates

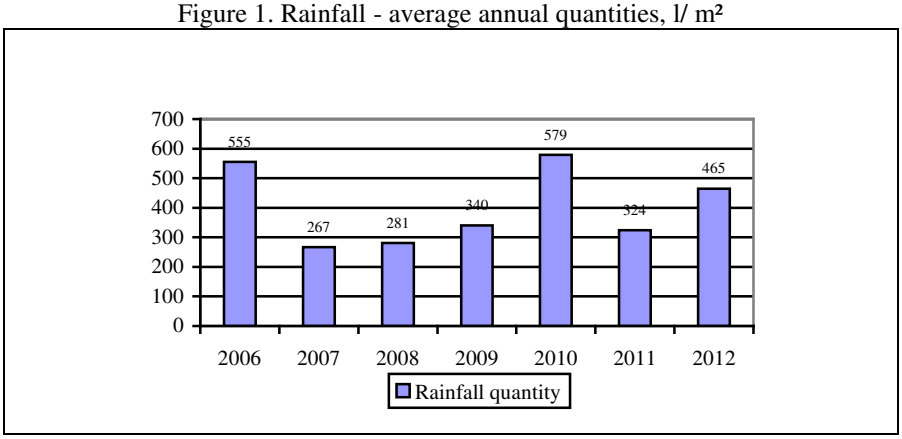
Annual temperature	2006	2007	2008	2009	2010	2011	2012
Maximum	36.6 VIII	41.1 VII	38.5 VIII	38.0 VII	37.2 VIII	32.4 VII	33.1 VII
Minimum	-20.3 I	-12.0 II	-15.1 I	-16.9 XII	-22.6 I	-13.7 I	-14.3 XII

Source: Rapoarte privind calitatea factorilor de mediu in judetul Braila, 2010- 2012 Agenţia pentru Protecţia Mediului Braila

Precipitations are distributed uniformly making that all the vegetation period the factor water to be under the drought limit, more stressed in July and August. The average annual precipitations are reduced and have a torrential character in summer leading to the destruction of the crops on large areas. During summer there emerge long intervals of drought (60-90 days). Thus, at level of the county Braila the year 2007 was the most droughty, registering the lowest annual average of the precipitations (267 l/m^2) while the year 2010 was the richest as regards the pluviometric regime (579 l/m^2).The annual average necessary of precipitations for the county Braila is of 524.6 l/m^2, this one being covered only in the years 2006 and 2010.

The moisture deficit in soil, in the period April – September, calculated as difference between evapotranspiration and rainfall is 300-350 mm/season. This deficit reveals the need of complementary irrigation of crops.

Figure 1. Rainfall - average annual quantities, l/ m²



Source: Raport privind calitatea factorilor de mediu în judeţul Brăila, 2010- 2012, Agenţia pentru Protecţia Mediului Braila

The aridity index Em de Martonne was calculated using the annual average values of the temperature (T) and precipitations (P) on a 7 years period, reflecting suggestively enough the variation of the continentalism degree and of the favorability of the climatic conditions for the vegetal carpet.

The lowest values of the aridity index (<22) are characteristic for the zones of maximum aridity (steppe) which correspond to the lowest annual level of precipitations (<450 mm). Values of the index 22-24, which correspond to the temperate continental domain with aridity influences specific for the temperate continental domain with diminuted aridity influences correspond to the silvo-steppe vegetal formations.

In the period 2006-2012, at the level of the Braila county, the aridity index calculated by the method Em de Martonne registered normal values in the years 2006 and 2010, in the rest of years registering very small values in ratio with the ideal value, thus the crops irrigation representing a necessary agrotechnical measure.

Tab.3

Aridity index at level of Braila county

Year	**Annual average precipitations l/m^2**	**Annual average temperatures ^{0}C**	**Aridity index**
2006	555	11.2	26.1
2007	267	12.5	11.8
2008	281	12.1	12.7
2009	340	12.0	15.4
2010	579	11.6	26.8
2011	324	11.3	15.2
2012	465	11.2	21.9

Source: own calculation after method Em de Martonne

In the period 2006-2012 the annual relative humidity of air can reach over 72%, it exceeds 80% in winter, while in summer it reaches only 65%.

In Braila county the solar radiation has high values, averagely 125 kcal/cm^2/year, linked to the duration of the sun shining which registers a number of 2200 h/year. Because of the long shiny days and of the high temperatures the saturation deficit increases much, fact which intensifies the evaporation process.

The wind blows in period autumn-spring mainly from the North and North-East direction, in the average speed being of 2.7-3.4 m/s. The high speed of the wind reduces much the humidity in the soil. The negative effect of the wind is felt especially in winter, when the snow is blown deeply, the crops being uncovered this way.

The maximum depth of freeze is of 0.85-0.90 m and the frequency of the frost days with temperatures smaller then 0 degrees is of over 95 days/year.

The annual rainfall amount does not cover the needs for obtaining high yields, and the water deficit must be covered by irrigations.

2. Land use

The soil is the main support to all the socio-economic activities and represents the environmental factor that is the most exposed to pollution.

Soil quality is determined by natural factors such as relief, climate, vegetation, time, as well as by anthropic factors. Thus, the agricultural practices that are not adapted to the environmental conditions, the treatments and fertilizer applications that did not respect the agro-pedological and agro-technical norms, the discharges of hazardous chemical substances, the storage of waste of all categories, represent anthropic factors that significantly and fast modify the quality of soils.

Tab. 4

Soil types characteristic to the county Braila, in the year 2012

Soil types	Area (ha)	Percentage (%)
Protisols	132090	34.1
Cernisols	202730	52.4
Hydrisols	36477	9.4
Salsodisols	15863	4.1
Total	**387160**	**100.00**

Source: Raport privind calitatea factorilor de mediu în judeţul Braila, 2012, Agenţia pentru Protecţia Mediului Braila

The soil and weather conditions from the county Braila determined the emergence and evolution of a various soil cover, where the chernozem soils prevail.

From the quality point of view the agricultural land areas in Braila county are inscribed in the II and III classes.

Tab. 5

Repartition of the land areas by quality classes in Braila county, 2011

- ha -

Nr. crt.		Quality classes of soils						
		I	II	III	IV	V	VI	Total (ha)
1.	Arable	23946	156385	114002	36522	18227	-	349089
2.	Pastures	-	621	13965	9751	8834	-	33171
3.	Vineyards	410	1555	1819	561	147	-	4492
4.	Orchards	2	242	357	39	-	-	640
	Total	24358	158803	130150	46873	27208	-	387392

Source: County Office for Pedological Studies, 2011

The soil quality is determined by natural factors as: relief, climate, vegetation, time, but also by anthropical factors. Thus, the agricultural practices not adapted to the environment conditions, the treatments and fertilizations made without agro-pedological, agrotehcnical foundations, the depletion of dangerous chemical substances, the deposit of the wastes of all categories, represent anthropical factors which modify sensibly and rapidly the soil quality.

Tab.6

Land areas affected by different degradations processes

- ha -

Types of processes	Weak	Moderate	Strongly	Very strong	Total area
Salinizated	48047	35732	35	6295	92109
Sodium accumulation	11058	-	-	7879	18937
Errosion	-	770	-	-	770
Humidity excess	-	10486	36477	-	46963
Total					158779

Source: Raport privind calitatea factorilor de mediu în judeţul Braila, 2011, Agenţia pentru Protecţia Mediului Braila

The salination process was affecting 92109 ha in the year 2011, and the humidity excess was affecting an area of 46963 ha. The two phenomena are the limitative elements especially active upon soil fertility.

In the county Braila, the agricultural land areas have the largest share in total land area, accounting for 81.43% in the year 2006 and 81.28% in the year 2010 of the total area of the county.

Tab.7

Distribution by land use categories in the period 2006-2012

Land use	Area (ha)						
	2006	2007	2008	2009	2010	2011	2012
Arable	349401	349830	353087	349089	350447	350447	350625
Pastures	33144	33274	28905	33171	31743	31733	31332
Vineyards	4825	4686	4840	4492	4519	4529	4545
Orchards	730	636	640	640	654	654	658
Agricultural total	388100	388428	387470	387392	387363	387363	387160
County total	476576						

Source: Raport privind calitatea factorilor de mediu în judeţul Brăila, 2012, Agenţia pentru Protecţia Mediului Brăila

In total agricultural land, arable land had the highest share (over 90%) throughout the investigated period.

3. Water resources

The county Braila has a significant surface water network and ground water reserves.

The surface water resources are the following:

- The Danube river, with 222.5 km length on the territory of Brăila county and an average transited water flow of 6200 m^3/s, supplies water for irrigations, fisheries, industry and drinking water for the population;
- The Buzău river, with 207.0 km length on the territory of Brăila county and average transited water flow of 26.32 m^3/s, supplies water for irrigations and industry;
- The Călmăţui river transits Brăila county only between the localities Jugureanu and Gura Călmăţui, with a length of 84 km, with an average transited water flow of 0.872 m^3/s and supplies water only for irrigation purposes;
- The Siret river, with 55 km length and an average transited water flow of 220 m^3/s supplies water for irrigations and fisheries;
- The Strachina river, an affluent of the Ialomiţa river, has a low number of local water uses.

The ground waters in Brăila county are phreatic waters located in the large river plains of the Danube, Siret, Buzău and Călmăţui rivers, at a depth ranging from 0 m in the low river plains to 20 m in the fields covered with sands and depth waters located either in gravel or in sandy deposits, their depth ranging from 50 to 200 m.

In the year 2012, the usable water resource from the surface resources accounted for 62.9% of the theoretical water resource from the surface resource, and the usable ground water resource accounted for 29.4% of the theoretical ground water resource.

4.4. Situation of land equipped with irrigation facilities

The irrigations system in the Braila county considered in the execution period (1967-1974), conceptually and constructively of a world level, was characterized by a series of particularities: size, construction solutions, water sources, the specific energy consumptions, the degree of finalizing the projects.

Thus, the irrigation systems and desiccations then were built in a much more different vision than the present requirements. There were built channels with very high lengths, the debits and the installed powers in the pumping stations and the costs associated to their functioning were enormous, and the numbers of the aggregates through water to be pumped for irrigations were impressive.

In the same vision also was the expansion of the agricultural area by desiccation of ponds and humid areas from which the water excess collected through desiccations channels to be eliminated also by pumping. These amendments constituted a major modification in a vulnerable space with adverse effects of climatic, hydrological, pedological and landscape nature.

Tab. 8

Situations of hydromeliorative amendments in Barila county, in the period 2007-2012

- ha -

	2007	2008	2009	2010	2011	2012
Total amendment area for irrigations	378469	378420	378420	378420	377077	377077
Total irrigated area with at least one watering	111776	90307	116342	53785	64598	...
Total amendment area for desiccation	268100	268100	268100	268100	268100	268100
Total amendment area for drainage	21923	21923	21923	21923	21923	21923

Source: INSSE- tempo online

In the period 2007-2012 the total amendment area for irrigation diminished, the main reason being the degradation, amplified by the lack of necessary funds for the maintenance and surveillance of the existent installations.

The main causes of the non-application of the irrigations on the areas amended was the high costs of the energy and the lack of watering installation on the private land areas.

The land reclamation infrastructure (irrigations and drainage) of the investigated area consists of the following types of works: hydrotechnical constructions for irrigations and drainage,

irrigation and drainage channels, water pumping stations for irrigations and drainage, hydro-mechanical installations (pumping aggregates, electric equipment, feeding and discharge pipelines) for irrigation and drainage.

The total length of channels in the county Braila is 5,870.65 km, out of which 1,203.55 km are for irrigations and 4,667.1 km for drainage, with 598 pumping stations (461 for irrigations and 137 for drainage), with a total installed power of 387MW, i.e. 359.4MW for irrigations and 27.7MW for drainage. The total pumping capacity is 2068 m^3/s for the whole system.

Irrigation is absolutely necessary in the conditions of the dry weather specific to the county Braila. Dryness was also favored by the increase of the demographic pressure and the climate changes.

The deviations from the optimum irrigation regime may have negative effects upon soil. Significant modifications may be produced due to the irrigation water quality, with the possible emergence of salinization and alkalization phenomena (in the situation of water containing salts), or texture modification (in case water contains alluvia).

CONCLUSIONS

From the data on the climate in the investigated area, it results a significant moisture deficit in the vegetation period of crops, which needs to be compensated by irrigations. Irrigations in the county Braila became absolutely necessary in the conditions of the arid and dry weather.

The dry weather was also aggravated by the increase of the demographic pressure and of climate changes. The deviations from the optimum irrigation regime may have negative effects upon soil. Significant modifications may appear due to irrigation water quality, the emergence of salinization and alkalization phenomena being possible (in the situation of waters that contain salts), as well as texture modification (when the water contains alluvia in suspension).

At present, the irrigation facilities are far from being used at their full capacity. The diminution of effectively irrigated areas is the result of cumulated factors, among which the most important are the following: decreased interest in irrigations from the part of small farmers lacking financial means; the land reform that led to extremely fragmented agricultural land areas and numerous parcels; high costs of crop irrigation; frequent institutional reorganizations.

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