STUDY OF CLIMATE EVOLUTION OF THE TITU-OGREZENI IRRIGATION SYSTEM PERIMETER BY ANALYSIS OF CLIMATIC DEFICIT

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Abstract
Our country's climate shows great changes both in time and space. These changes are also reflected on agricultural productions that also sometime presents substantial differences from one year to another and from one area to another. Based on statistical analyses on large arrays of years, it results that in Romania, the dry years are in very high proportion going up to 70%.
For getting to knowing requirements from water of major agricultural crops, by the study achieved mainly the necessary dimensioning of water for irrigations using the climate deficit method has been considered.
From the chronological sequence analysis of years, under the climatic deficit, the change of this in a positive way that leads to the need for irrigations is come out. Given the set of climatic parameters, the model that approximates the best the evolution tendency as some parametrical equations has been studied. Since 2009, for the next 57 years the trend line of the evolution of climatic deficit is clearly increasing in the months May-August.

Keywords: climatic deficit, potential evaporation- sweat, not exceeding insurance, monthly net norm of irrigation, rainfall.

1. INTRODUCTION

On the irrigated lands, with the optimal soil moisture, covered with dense uniform cultures, the total consumption of water from soil has maximum values and coincides with the term of potential evaporation-sweat (ET_P), and for moisture and vegetation conditions existing at a time, the actual evaporation-sweat one.
The deficit climatic is determined by comparison between the total water consumption (potential evaporation-sweat) and soil moisture provided in soil by rainfall [1]:

$$\Delta = ET_p - P \qquad (1)$$

Study objectives:
- Presentation of the methodology for calculating the water requirement for irrigation for each month of warm season and at various insurance of calculation (50% and 80%) using the climatic deficit method [2];
- Presentation of climatic evolution chronological sequence of the years 1966-2008 and the evolution tendency of climatic deficit until 2065.

2. CALCULATION OF NET NORMS OF MONTHLY IRRIGATION AT DIFFERENT CALCULATION ENSURING

With climate data from Titu meteorological station, of influence on the Ogrezeni Titu irrigation system, "climate deficit ($\Delta = ET_P$-P) for the expression of the two parameters of calculation (M_o şi ET_r) has been used [3];

$$M_o = k\,(ET_p - P) = k \cdot \Delta \qquad (2)$$

$$ET_r = \lambda\,(ET_p - P) = \lambda \cdot \Delta \qquad (3)$$

Using the d_c, d_s, η_a, c_v and α, coefficients, it is demonstrated that the two parameters (k) and (λ) have the following expressions:

$$k = \eta_a \frac{d_c(1-d_s)-\alpha}{1-\alpha} \qquad (4)$$

$$\lambda = k + \frac{d_c \cdot d_s + c_v \cdot \alpha}{1-\alpha} \qquad (5)$$

- d_s is the coefficient of soil, coefficient indicating the participation share of water from soil at the covering consumption by

evaporation-sweat calculated on the experimental fields ICITID;
- d_c is the crop coefficient. It is come out that (d_s) and (d_c) are coefficients whose values result from the data published in our literature.
From many calculation relations of potential evaporation-sweat (ET_p) the climatic parameters are used, in Romania, the Thornthwaite's equation has been used employing the average values of monthly temperatures and the latitude of Titu meteorological station of influence on the Titu-Ogrezeni irrigation system:

$$ETp_{ji} = 16 \cdot \left(\frac{10 \cdot t_{ji}}{I} \right)^a \cdot k_i \quad \left[\frac{mm}{ha \cdot month} \right] \qquad (6)$$

where:
- ETp_{ji} - is potential **evaporation-sweat** for the calculation month (j) from the year (i);
- t_{ji} - is average temperature (^{0}C) of every calculation month (i) from the year (i);
- I - is thermal index of area where the meteorology statio n is located and the surface arranged for irrigation calculated with the relation:

$$I = \sum_{J=1}^{J=12} i_{nj} = \sum_{J=1}^{J=12} \left(\frac{t_{nj}}{5} \right)^{1,514} \qquad (7)$$

(valabilă pentru $t_{nj} > 0$)

The parameters values (a) and (l) are constant for a meteorological station and during the years of observation (N). The terms significance from the relation (7) is the following:
- i_n - is thermal index of month (j), whose values are according to the multiannual average temperature of air in this month (t_{nj});
- t_n -is the multiannual average temperature of every month of calculation (I-XII), or normal of calculation month, ^{0}C;
- a -is a empiric parameter determined by the relation:

$$a=(6,75 \cdot I^3 – 771 \cdot I^2 + 179200 \cdot I + 4923900) \cdot 10^{-7} \qquad (8)$$

- k_i - is a luminosity coefficient properly to geographical position of meteorological station.
To calculation of potential evaporation-sweat ET_p the following indexes are determined:
- multiannual average temperature t_n, (^{0}C) for every month for the period of (N) years;
- thermal index in the month (j): $i_{nj}=(t_{nj}/5)^{1,514}$ for $t_{nj}>0$;
- thermal index of the area, from relation (7) : $I=\sum i_{nj}$;
– empiric parameter "a", according to relation (8).
It is come out that the climatic factors which rule the consumption process by evaporation-sweat are integrated in the climatic deficit $\Delta=ET_p – P$, that monthly varies along the (N) whole row of years.
But, at the same climatic deficit state (Δ) every crop that differently influences both as consumption rhythm (ET_r) and by need irrigation standard (M_o), influence expressed by the two parameters (k) and (λ) calculated with the relations (4) and (5). That is why, the calculation ensuring is applied only to establish the value $\Delta=ET_p – P$ to the two levels:
- ensuring *of not exceeding deficit of 80%,* with values distributed over the months IV-IX, necessary hydraulic dimensioning and constructive of system for the month of maximum water consumption for irrigation (July) and verifying the source volume;
- *ensuring of not exceeding deficit of 50%* with values distributed over the months IV-IX, necessary base for economic and technical efficiency of investment, constructions and equipping of the system as well as operating parameters multiannual: net consumption of water for irrigation, average power consumption for pumping water, average multiannual expenditure for maintenance and repairs. In order to determine the insurance parameters of calculation thee stages are run:
- *stage I, which sets parameters (ET_P, P, Δ) for each month of the row of (N) years analyzed;*
Table 1 is drawn. On the right side of the table calculations necessary to determine the insured values of the three parameters (ETP, P, Δ) is running, as follows:

- in column (19) the algebraic sum of the climatic deficit in the period April - September, of each year, in chronological order $\Delta_i = \left(\sum_{IV}^{IX} \Delta_j\right)$ is listed;
- in the column (20) chronologic year, copying column (0) is listed;
- in column (21) the chronological sequence $\in 1$
- N are numbered;
- in column (22) not exceeding the insurance value (An) corresponding year (i) calculated by the empirical relationship Cegodaev is written:

$$Year_i \cong 100 \cdot \frac{N - i + 0.7}{N + 0.4}, \% \qquad (9)$$

- in column (23) the values (Δi) from column (19) in descending order: $(\Delta i)_{max}$ ..... $(\Delta i)_{min}$ is written. Simultaneously the column (24) is filled, identifying the year corresponding value (Δi) from column (23).

- *stage II, which established parameters (ET_P, P, Δ) for each month in insurance of:*

a) – 80%

- from column (22) of Table 1 at around 80% 5 successive values over 80% and 5 successive values below 80%, resulting a total number of 11 values are taken;
- every insurance from the 11 values (i) a certain value $\left(\sum_{IV}^{IX} \Delta_j\right)_i$ of the same table in column (23) results;
- every value $\left(\sum_{IV}^{IX} \Delta_j\right)_i$ from the column (23) and it is identified in the column (19) is taken, then all value of respective year are introduced into Table 2.
- arithmetic average of values row (11) for parameters (ET_P, P, Δ) for each month (j) of the warm season (IV - IX) corresponding to insurance An ≈ 80%.

b) – 50%

- to reduce the calculation volume, for the ensuring of 50% the average annual values from Table 1, last line are accepted.

To establish the monthly irrigation limits of 80% an 50% some stages are run:

a) Optimization of crop plan and the establishment of crop coefficients (d_C) and soil (d_s):

b) Calculation of irrigation monthly norm to ensure 80% contains:

the values of climatic parameters (ET_P, P and Δ) for each month are found the last line of Table 5, (average values) and are the same for all crops;

→ determine the coefficient $\alpha j = Pj / ETpj$ for each month (j) of vegetation season

→ using the relation (4) the parameter (k_{ij}) for each crop (i) in the calculation month (j) is alculated; (for $k_{ij} \leq 0$, it does not irrigate; $M_{0il}=0$)

→using the relation $M_{0ij}=k_{ij}\cdot \Delta_j$ the monthly irrigation norm for a crop (i) and month (j) is calculated;

→ *after calculating norms of all crops that are irrigated in one month (i) the monthly irrigation norm as weighted average on the crop plan is calculated*

$i \in (1...10)$ for the month j:

$$Mo_{j.med.pond.} = \frac{\sum_{i=1}^{i=2...10}\left(p_i \times Mo_{ij}\right)}{100}\left[\frac{mm}{ha \cdot month(j)}\right] \qquad (10)$$

→ specific flow rate in the month (j)

$$q_j\left(\frac{l}{s \cdot ha}\right) = \frac{Mo_{j.med.pond}}{8.64 \cdot T} \qquad \frac{\left(\frac{mm}{ha \cdot month}\right)}{\left(\frac{days}{month}\right)} \qquad (11)$$

c) The calculation of the monthly irrigation norm at the ensure of 50%

→ values of climatic parameters (ET_P, P, Δ) are the values determined at the ensuring of 50% (last line of Table 2);

d) *It is the graphic representation of changes in specific flow rates (q) in the season months of vegetation at the providing 80% and 50%.*

3. EVOUTION TRENDENCY OF CLIMATIC DEFICIT FOR EACH MONTH OF WARM SEASON

The climatic evolution of the area was highlighted by analyzing data from the Titu meteorological station for a period of 43 years (1966-2008) on the dynamics of potential

evaporation-sweat, the rainfall and climatic deficit of water (as the difference between the two sizes). The following issues [4,5] are separated:

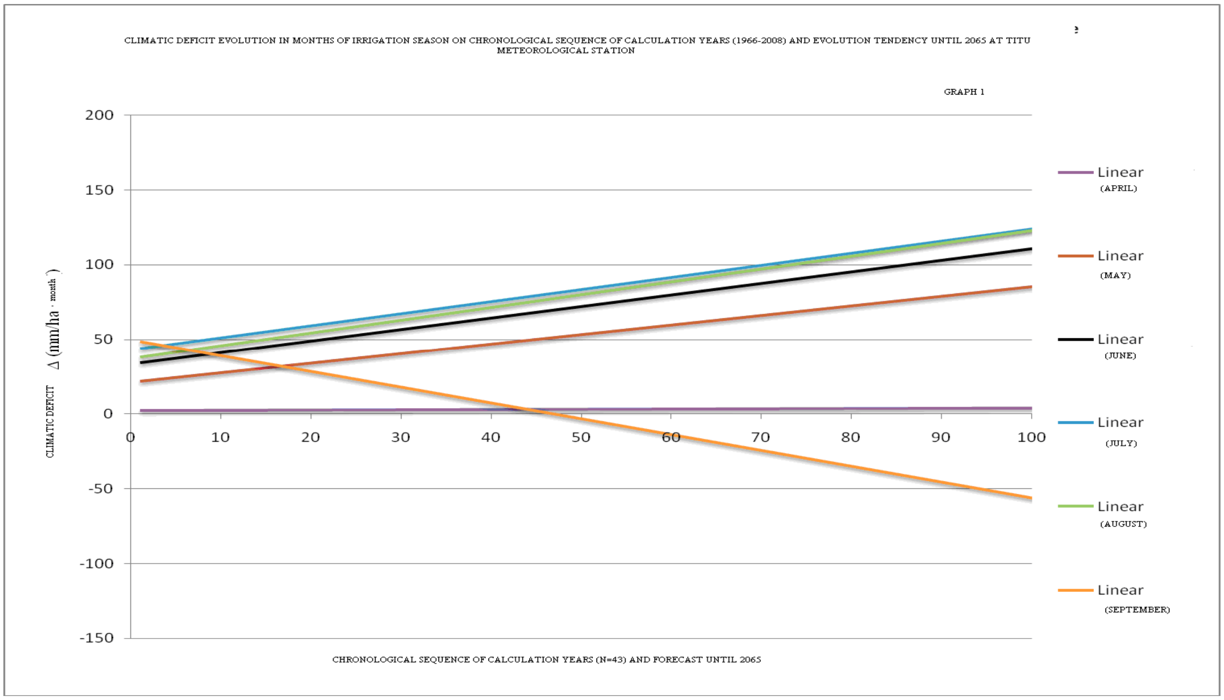

Figure 1 Evoution trendency of climatic deficit for each month of warm season

■ In terms of rain-measurement during 1966-2008, it was revealed alternating rainy years (annual quantities greater than 700 mm) with poor rainfall years (annual amount less than 500mm).

■ From the chronological sequence analysis of calculation year, as the climatic deficit the following aspects are come out:

* - In April of vegetation season, as a percentage of 60.5% of observation period the climatic deficit values are positive, watering is necessary to apply, and in 39.5% from period, irrigation are not required;

* - In May of vegetation season, in 76.7% of years positive values of climate deficit are recorded, requiring the application of irrigation, and 23.3% of years the rainfall quantities exceed potential evaporation-sweat values watering are not necessary;

***** - In June, the values of climatic deficit are positive in 88.4% in the years studied, which requires the need for watering, and in 11.6% of years significant drop of rainfall are recorded and watering is not necessary;

***** - the months July and August present in 86% of studied years the positive values of the climatic deficit , the application watering is received;

***** - In September, 74.4% of the years studied, the positive values of climatic deficit are shown, which requires the implementation of irrigation;

■ Given this set of climatic parameters, the issue of finding a model that best approximate the tendency of the data evolution as parametric equations arises. This model is the linear model, the linear regression function as form:

$$y = ax+b$$

Calculations have been made with EXCEL spreadsheet program. The cloud of points corresponding to the two vectors (chronological years and climatic deficit) is achieved regarding the data table as a linear function. It points out a point's graphic of type XY (Scatter).

Table 1 Calculated values (ETP_{ji}) and (Δ_{ji}) during period 1966-2008 (N=43) and ensuring calculation to the Titu station

Year	April			May			June			July			August			September			Deficit sum	Ensuring calculation				
	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ		Chron. year	Crt. no.	Ens. (%)	Ordered deficit sum	Identif year
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1966	60,9	40,1	20,8	91,6	36,1	55,5	108,9	71,1	37,8	138,5	108,3	30,2	122,3	52,6	69,7	74,5	38,8	35,7	249,7	1966	1	98,4	432,7	2007
1967	48,0	75,9	-27,9	94,2	91,8	2,4	110,6	94,2	16,4	139,9	36,4	103,5	125,8	45,9	79,9	85,7	63,9	21,8	196,1	1967	2	96,1	398,1	2000
1968	66,1	3,2	62,9	116,6	11,7	104,9	131,4	32,6	98,8	135,2	32,1	103,1	111,9	127,5	-15,6	79,7	80,3	-0,6	353,5	1968	3	93,8	389,2	1985
1969	44,4	31,4	13,0	110,9	11,7	99,2	113,3	189,1	-75,8	121,8	93,0	28,8	118,1	124,8	-6,7	76,2	32,5	43,7	102,2	1969	4	91,4	377,7	1992
1970	59,1	101,6	-42,5	82,0	109,6	-27,6	117,8	67,5	50,3	136,2	112,9	23,3	113,9	89,5	24,4	72,2	11,9	60,3	88,2	1970	5	89,1	373,9	2003
1971	45,9	36,1	9,8	96,7	147,9	-51,2	118,4	32,4	86,0	125,4	74,5	50,9	122,3	111,7	10,6	67,2	130,5	-63,3	42,8	1971	6	86,9	353,5	1968
1972	65,6	26,9	38,7	95,9	105,0	-9,1	132,7	51,4	81,3	137,7	101,8	35,9	116,7	96,6	20,1	66,6	146,4	-79,8	87,1	1972	7	84,5	350,1	1989
1973	50,4	65,1	-14,7	96,7	52,6	44,1	116,4	65,9	50,5	130,0	67,4	62,6	109,6	43,2	66,4	77,5	24,0	53,5	262,4	1973	8	82,2	342,4	1990
1974	35,9	50,3	-14,4	85,5	51,7	33,8	113,3	76,5	36,8	130,0	140,8	-10,8	125,8	18,7	107,1	81,5	37,1	44,4	196,9	1974	9	80,0	337,0	1981
1975	57,49	55,8	1,6	100,1	116,2	-16,1	125,4	117,8	7,6	133,7	200,3	-66,6	115,0	50,2	64,8	91,3	10,9	80,4	71,7	1975	10	77,6	327,5	2008
1976	51,52	59,0	-7,5	88,8	32,3	56,5	106,9	36,7	70,2	129,1	64,8	64,3	94,1	105,7	-11,6	70,0	42,3	27,7	199,6	1976	11	75,3	327,4	1986
1977	47,00	80,0	-33,0	90,4	58,0	32,4	113,3	75,7	37,6	136,2	9,8	126,4	116,7	132,8	-16,1	67,2	40,3	26,9	174,2	1977	12	73,0	322,1	1995
1978	45,9	34,7	11,2	78,6	104,8	-26,2	113,9	86,4	27,5	129,1	29,8	99,3	108,3	19,2	89,1	67,2	100,7	-33,5	167,4	1978	13	70,8	316,1	1982
1979	43,57	54,9	-11,4	99,5	84,2	15,3	131,4	171,7	-40,3	116,7	192,5	-75,8	110,8	78,9	31,9	81,0	16,3	64,7	-15,6	1979	14	68,4	308,9	1987
1980	42,67	60,2	-17,6	76,6	79,6	-3,0	116,4	53,7	62,7	131,0	86,8	44,2	108,3	39,4	68,9	70,1	27,0	43,1	198,3	1980	15	66,1	298,3	1993
1981	46,47	41,0	5,4	82,7	53,5	29,2	134,2	41,5	92,7	127,1	32,1	95,0	114,4	41,8	72,6	78,0	35,9	42,1	337,0	1981	16	63,8	297,6	1996
1982	38,87	31,3	7,5	100,1	11,2	88,9	123,6	41,2	82,4	124,6	89,2	35,4	117,3	61,3	56,0	88,7	42,8	45,9	316,1	1982	17	61,5	270,2	1998
1983	59,84	24,5	35,3	102,2	36,7	65,5	112,7	131,5	-18,8	137,1	49,8	87,3	113,1	78,6	34,5	80,2	18,8	61,4	265,2	1983	18	59,2	265,2	1983
1984	38,87	59,0	-20,2	94,0	52,0	42,0	109,0	66,8	42,2	122,5	43,9	78,6	104,8	80,3	24,5	83,2	18,2	65,0	232,1	1984	19	56,9	264,2	1994
1985	59,10	17,9	41,2	108,9	43,7	65,2	117,8	37,5	80,3	133,7	68,8	64,9	124,2	37,6	86,6	74,0	23,0	51,0	389,2	1985	20	54,6	262,4	1973
1986	62,74	16,3	46,4	104,6	20,5	84,1	120,9	76,4	44,5	124,0	64,8	59,2	125,8	88,6	37,2	78,0	22,0	56,0	327,4	1986	21	52,3	256,2	1988
1987	39,2	74,4	-35,2	79,8	104,6	-24,8	127,6	35,9	91,7	150,0	25,7	124,3	112,5	32,8	79,7	90,3	17,1	73,2	308,9	1987	22	50,0	255,1	2002
1988	41,0	83,0	-42,0	91,0	89,9	1,1	123,0	48,4	74,6	153,9	78,2	75,7	123,4	14,5	108,9	78,5	40,6	37,9	256,2	1988	23	47,7	249,7	1966
1989	62,7	49,7	13,0	86,8	51,7	35,1	112,1	66,0	46,1	132,4	23,2	109,2	127,1	29,6	97,5	75,0	25,8	49,2	350,1	1989	24	45,3	248,1	2006
1990	49,3	20,9	28,4	90,4	18,4	72,0	119,5	28,8	90,7	135,2	37,7	97,5	119,2	97,9	21,3	70,0	37,5	32,5	342,4	1990	25	43,1	232,1	1984
1991	43,2	86,1	-42,9	73,1	116,5	-43,4	123,0	111,8	11,2	139,1	166,4	-27,3	114,4	29,4	85,0	76,2	9,4	66,8	49,4	1991	26	40,8	224,1	2004
1992	50,9	23,8	27,1	85,5	39,5	46,0	121,6	86,3	35,3	133,7	60,7	73,0	138,4	5,8	132,6	71,7	8,0	63,7	377,7	1992	27	38,4	199,6	1976
1993	44,4	16,0	28,4	99,0	109,2	-10,2	123,6	59,1	64,5	130,0	50,8	79,2	121,0	33,1	87,9	72,7	24,2	48,5	298,3	1993	28	36,2	198,3	1980
1994	58,3	41,8	16,5	102,2	17,5	84,7	124,6	119,7	4,9	140,0	156,0	-16,0	127,9	36,7	91,2	99,7	16,8	82,9	264,2	1994	29	33,9	196,9	1974
1995	49,3	14,5	34,8	88,8	56,7	32,1	116,4	40,0	76,4	148,5	41,4	107,1	119,2	31,3	87,9	72,7	88,9	-16,2	322,1	1995	30	31,6	196,1	1967
1996	45,9	55,0	-9,1	115,8	48,2	67,6	136,6	89,9	46,7	139,1	23,3	115,9	119,2	40,6	78,6	63,7	65,8	-2,1	297,6	1996	31	29,2	194,5	1999
1997	29,8	154,7	-124,9	103,8	70,1	33,7	130,6	41,4	89,2	130,0	96,6	33,4	112,5	207,2	-94,7	64,9	13,1	51,8	-11,5	1997	32	26,9	186,7	2001
1998	63,4	19,1	44,3	93,1	86,4	6,7	432,1	48,7	83,4	145,1	51,8	93,3	129,8	38,3	91,5	70,0	119,0	-49,0	270,2	1998	33	24,7	174,2	1977
1999	55,8	79,5	-23,7	89,8	59,0	30,8	137,4	42,3	95,1	151,8	73,3	78,5	125,2	119,8	5,4	83,7	75,3	8,4	194,5	1999	34	22,3	167,4	1978
2000	68,7	18,1	50,6	107,3	8,5	98,8	134,2	62,8	71,4	146,4	47,3	99,1	135,2	22,7	112,5	72,2	106,5	-34,3	398,1	2000	35	20,0	102,2	1969
2001	50,9	46,0	4,9	97,3	21,9	75,4	115,0	228,5	-113,5	148,5	59,1	89,4	135,2	40,0	95,2	79,7	44,4	35,3	186,7	2001	36	17,7	88,2	1970
2002	47,0	29,5	17,5	109,5	11,5	98,0	136,0	60,0	76,0	152,4	175,4	-23,0	119,2	42,9	76,3	75,7	65,4	10,3	255,1	2002	37	15,4	87,1	1972
2003	45,5	52,8	-7,3	125,0	38,1	86,9	142,0	30,6	111,4	143,1	31,9	111,2	139,2	29,3	109,9	73,5	111,7	-38,2	373,9	2003	38	13,1	71,7	1975
2004	54,4	41,4	13,0	85,5	110,0	-24,5	120,3	50,6	69,7	140,0	69,5	70,5	120,0	47,9	72,1	78,0	54,7	23,3	224,1	2004	39	10,8	49,4	1991
2005	50,9	50,2	0,7	101,6	72,4	29,2	113,9	121,7	-7,8	135,2	149,2	-14,0	121,0	163,8	-42,8	78,5	199,6	-121,1	-155,8	2005	40	8,5	42,8	1971
2006	56,4	50,6	5,8	94,7	46,4	48,3	123,6	45,2	78,4	143,7	42,8	100,9	122,3	100,8	21,5	81,0	87,8	-6,8	248,1	2006	41	6,2	-11,5	1997
2007	57,4	4,4	53,0	110,9	88,8	22,1	143,4	32,0	111,4	164,9	15,0	149,9	136,5	78,8	57,7	74,0	35,4	38,6	432,7	2007	42	3,9	-15,6	1979
2008	59,8	103,6	-43,8	95,3	22,8	72,5	133,5	33,0	100,5	140,0	89,0	51,0	138,4	0,2	138,2	73,5	64,4	9,1	327,5	2008	43	1,6	-155,8	2005
Average	**51,0**	**48,4**	**2,6**	**95,8**	**60,4**	**35,4**	**122,7**	**72,1**	**50,6**	**136,8**	**75,9**	**60,9**	**120,3**	**64,3**	**56,0**	**76,4**	**52,9**	**23,5**						

Table 2 Determination of climatic parameters (ETp, P şi Δ) in the months of vegetation season (IV-IX) to ensuring of 80%

Crt no.	Year ens.%	$\sum_{IV}^{IX} \Delta i$	Year	April			May			June			July			August			September		
				ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ	ETp	P	Δ
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	91,4	377,8	1992	50,9	23,8	27,1	85,5	39,5	46,0	121,6	86,3	35,3	133,7	60,7	73,0	138,4	5,8	132,6	71,7	8,0	63,7
2	89,1	373,9	2003	45,5	52,8	-7,3	125,0	38,1	86,9	142,0	30,6	111,4	143,1	31,9	111,2	139,2	29,3	109,9	73,5	111,7	-38,2
3	86,9	353,5	1968	66,1	3,2	62,9	116,6	11,7	104,9	131,4	32,6	98,8	135,2	32,1	103,1	111,9	127,5	-15,6	79,7	80,3	-0,6
4	84,5	350,1	1989	62,7	49,7	13,0	86,8	51,7	35,1	112,1	66,0	46,1	132,4	23,2	109,2	127,1	29,6	97,5	75,0	25,8	49,2
5	82,2	342,4	1990	49,3	20,9	28,4	90,4	18,4	72,0	119,5	28,8	90,7	135,2	37,7	97,5	119,2	97,9	21,3	70,0	37,5	32,5
6	80,0	337,0	1981	46,4	41,0	5,4	82,7	53,5	29,2	134,2	41,5	92,7	127,1	32,1	95,0	114,4	41,8	72,6	78,0	35,9	42,1
7	77,6	327,5	2008	59,8	103,6	-43,8	95,3	22,8	72,5	133,5	33,0	100,5	140,0	89,0	51,0	138,4	0,2	138,2	73,5	64,4	9,1
8	75,3	327,4	1986	62,7	16,3	46,4	104,6	20,5	84,1	120,9	76,4	44,5	124,0	64,8	59,2	125,8	88,6	37,2	78,0	22,0	56,0
9	73,0	322,1	1995	49,3	14,5	34,8	88,8	56,7	32,1	116,4	40,0	76,4	148,5	41,4	107,1	119,2	31,3	87,9	72,7	88,9	-16,2
10	70,8	316,1	1982	38,8	31,3	7,5	100,1	11,2	88,9	123,6	41,2	82,4	124,6	89,2	35,4	117,3	61,3	56,0	88,7	42,8	45,9
11	68,4	308,9	1987	39,2	74,4	-35,2	79,8	104,6	-24,8	127,6	35,9	91,7	150,0	25,7	124,3	112,5	32,8	79,7	90,3	17,1	73,2
Media Average				51,9	39,2	12,7	96,0	39,0	57,0	125,7	46,6	79,1	135,8	48,0	87,8	123,9	49,6	74,3	77,3	48,5	28,8

■ Given the Δ values in Table 1 is the graphical representation of the evolution of climatic deficit in the months of irrigation season using the ADD TRENDLINE model (figure 1) is made.

■ Since 2009, for the next 57 years the trend line of the evolution of climatic deficit is clearly increasing in the months May-August.

4. REFERENCES

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