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THE IMPACT OF CLIMATIC HAZARDS ON ENVIRONMENT IN THE TÂRGOVIŞTE PLAIN

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ABSTRACT – The analysis of the main climate elements allows the characterization of the geographical area of the Târgovişte Plain from the climatic viewpoint (located at the contact of two major physical-geographical units, the Sub-Carpathians and the plateau, the Târgovişte Plain has benefited from the natural and human resources offered by the two units, as well as by the presence of the Ialomița and the Dâmbovița rivers on the margins; within the Romanian Plain, the Târgovişte Plain has a peripheral position, being bordered by the subsidence plain of Titu-Sălcuța in the south, south-west and south-east, and by the piedmont plain of Cricovul Dulce). This analysis was made based on the data recorded at the weather station of Târgovişte (located at 228 m altitude, $44^0$56' N latitude, $25^0$26' E longitude) and at the weather station of Titu (125 m altitude, $45^0$36' latitude N, $26^0$25' longitude E) during the period between 1961 and 2007. The annual, seasonal and monthly values of the Standardized Precipitation Anomaly (SPA) was calculated and interpreted.

Key words: climatic risks, cold waves, heat waves, the Târgovişte Plain

1. INTRODUCTION

The hydro-meteorological (climatic) hazards, by their impact on the environment and on the socio-economic activities, trigger natural and ecological imbalances, having a negative influence on the ecosystem evolution. The research on the global climate changes and the climatic hazard management aim to monitor their way of manifestation in time and space, to valorize databases, especially the satellite ones, to make an inventory of the damages and, last but not least, to elaborate programs for the reconstruction of the environment and of the affected areas.

As far as the air circulation is concerned, the Târgovişte Plain is situated at the crossroads of the eastern and western air masses. Characteristic for this area are both the humid air masses, with anticyclonal regime (from the Azore anticyclone, which determines richer precipitations in May-June and July), and the dry air masses, with anticyclonal regime (the North-Uralian anticyclone), which lead to the decrease of the air temperature during winter.

The analysis of the main climatic elements allows the characterization of the geographic area of the Târgovişte Plain from a climatic viewpoint.

The non-periodical climatic variation is highlighted by numerous extreme phenomena. They are the direct result of the encounter between the general air circulation and the characteristics of the active subjacent surface, and they can have a general, regional and local character.

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2. METHODOLOGY

In the present analysis, we have taken into account the thermal hazards (heat and cold waves) and pluviometric hazards (periods of too much or too little rain). We have used the climatic data (temperatures and precipitations) coming from two meteorological stations, Târgovişte - 228 m altitude and Titu -125 m altitude, for the period 1961-2007.

The most intense warming / cooling phenomena were considered those when the extreme monthly temperatures go over certain threshold values: the monthly absolute maximum temperature ≥35°C or the monthly absolute minimum temperature ≤-20°C.

As far as the study of the periods with too much / too little rain are concerned, we have calculated and interpreted the annual, seasonal and monthly values of the Standardized Precipitation Anomaly (SPA), expressed by the formula:

$$SPA = (X_i - X_{med})/\delta,$$

where: x_i = the term in the row; x_{med} = average of the row; δ = mean-square deviation (standard deviation).

We considered to be cases of too much rain the situations when the SPA value went beyond 1.0, and cases of too little rain the situations when the SPA value was lower than -1.0.

Table 1. *Pluviometric characterization of the time intervals according to the SPA value*

>2.50	exceptionally rainy
2.01… 2.50	excessively rainy
1.51… 2.00	very rainy
1.01… 1.50	rainy
0.50… 1.00	a little rainy
-0.50… 0.50	normal
-1.00…-0.51	a little dry
-1.50…-1.01	dry
-2.00…-1.51	very dry
-2.50…-2.01	excessively dry
<-2.50	exceptionally dry

3. HEAT WAVES

In the present analysis, the heat waves are highlighted by hot days (monthly absolute maximum temperature ≥35°C).

The hottest intervals (maximum daytime temperature ≥35°C) of the period 1961-2007 occurred in: June 1969, 1982, 1993, 1997, 2000, 2002; July 1963, 1965, 1968, 1973, 1974, 1980, 1985, 1987, 1988, 1996, 2000, 2003, 2007; August 1963, 1965, 1971,1977, 1992, 1993, 1994, 1998, 1999, 2000, 2007; September 1986, 1987.

During the period under analysis, 32 phases of massive heat were recorded (when the absolute daytime temperature was ≥35°C). The highest frequency occurred in July 1987, 2007, and August 2000, to which we can add August 1968, July and August 2000.

The absolute maximum temperature went over 40°C twice at Titu station: 40.2°C in July 1987 and 40.6°C in July 2007.

July 1965 represents the month when at both of these meteorological stations, temperatures over 37˚C were registered (Târgovişte 38.2°C and Titu 37.8°C).

July 1985 represents a strong heat wave that occurred during the last decade. During this month, the average temperature went beyond 25°C. The intensity of this heat is marked also by the

absolute maximum temperatures whose values oscillated between 38˚C and 38.2°C, exceeding by 12-13°C the average temperature of the respective month.

During the cold months, the advection of tropical air determines an increase in the air temperature exceeding by far the normal situation for this season. In the circumstances of the existence of a thick layer of snow, the higher temperatures can generate the sudden melting of snow and the melting of the frozen waters, triggering the danger of floods.

July 1987 and July 2007 are the two months when absolute maximum values were recorded in the region under consideration. The presence of a vast depression area over the Pannonian Plain drew over Romania the hot tropical continental air from the south of the Russian Plain (Bogdan, Niculescu, 1999).

Table 2. *Parameters of the air temperature in July*

Station	Multiannual average temperature of July (1961-2007)	Average temperature of July 1987	Absolute maximum temperature July 1987	Average temperature of July 2007	Absolute maximum temperature July 2007
Târgovişte	19.2	20.8	39.1	24.7	39.3
Titu	20.9	23.3	40.2	25.4	40.6*

* absolute maximum temperature of the region

The hottest heat wave that occurred in Târgovişte Plain, which holds as well the record for most absolute maximum thermal values, occurred in July 2007. ***July 2007*** appears to be the hottest month during the last decade, when the average temperature went beyond 22°C (Târgovişte 24.7˚C and Titu 25.4˚C). The maximum temperature went over 30°C all over the plain and the meteorologists recorded 20-30 tropical days. The maximum intensity of this warming had two phases, when the maximum values of the air temperature went over 35°C: (Târgovişte 39.3˚C and Titu 40.6˚C).

Table 3. *Maximum temperatures recorded during the summer of 2007 (the months of June, July, and August)*

Station	June	July	August
Târgovişte	36.7	39.3	38.6
Titu	38.2	40.6	39.2

Excessive warming periods, with temperatures much above the average situations can appear during other months as well, not just during the summer months. Such an example is the month of ***September 1986*** and ***September 1987*** when temperatures went over 20°C from the very beginning of the month. The maximum temperatures were higher than 34°C, reaching 35°C (Târgovişte) and even 35.6°C (Titu).

4. COLD WAVES

In the present analysis, the most severe cooling periods were considered those during which the monthly minimum temperatures reach or go below -20°C.

The most severe cooling periods of the last century occurred during the months of January: 1954, 1963, 1968, 1969, 1972, 1980, 1985, 2000; February: 1950, 1954, 1956, 1963, 1965, 1985; December: 1998.

The highest frequency of such cold days occurred in January 1963, to which we can add January 1965, 1980, 1985, 2000, and February 1965, 1985. In more than 65% (13 years) of the total number of years with massive cooling periods, only one such cooling period occurred during the year.

During the massive cooling phases, absolute minimum temperatures ≤-26°C were recorded at Titu station; the minimum temperature went below this value three times (-27.4°C, -26.2°C, and -29.6°C).

January 1963. This month records a massive cooling because of the penetration of polar continental air masses coming from the north of the continent. In this situation, the air temperature became much lower than usual, and the meteorologists registered the most numerous absolute minimum temperatures.

During the same month, the minimum temperature went down to -29.6°C (Târgovişte), being by 19-20°C lower than the average of the same month and by 26-28°C below the multiannual average temperature of the month of January. For Târgovişte, this value remained the absolute minimum temperature so far.

This month represents, for the high plain of Târgovişte, the coldest month of the last decade. The average temperature of the month of January 1963 was -6.3°C (Târgovişte) and -6.9°C (Titu).

Another parameter that can measure the intensity of this cooling is represented by the frequency of the days with different characteristic negative temperatures. In the case of the days with frost, 29-30 days/month were recorded at the meteorological stations. Winter days were recorded in 21 cases / month at Târgovişte, and 22 cases / month at Titu.

Table 4. *Parameters of the air temperature during the month of January 1963*

Station	Multiannual average temperature for the month of January (1963-2007)	Average temp. for the month of January 1963	ΔT (°C)	Absolute minimum temp. of the month of January 1963	Data of occurrence of the absolute minimum temp.	ΔT (°C) (Absolute minimum temp. of January – multiannual average temp. for January)	ΔT (°C) (Absolute minimum temp. of January 1963 – average temp. for January 1963)
Târgovişte	-1.8	-8.1	-6.3	-25.5	17	-23.7	-17.4
Titu*	-2.5	-9.4	-6.9	-29.6	25	-27.1	-10.2

** absolute minimum temperature*

January 1980 recorded a phase of intense cooling, while the winter of 1980 was one with the most severe winters of the last century. The negative deviations of the average temperatures compared to the multiannual average varied, in the case of all stations under consideration, between 4.6° and 4.8°C.

Ianuarie 1985 registered an intense cooling. The average temperature became lower than -5.5 (Târgovişte) and even -7°C (Titu), the average deviation being of -3…-4°C. At Târgovişte station, the minimum temperature ranged between -20 and -23°C, and at Titu station it went below -25°C. Thus, on January 13, the minimum temperature went down to -27.4°C at Titu. In February 1985, temperatures of -24.6°C were registered at Titu station.

5. PERIODS OF TOO MUCH RAIN

Annual pluviometric excess

The frequency of the years with rain surplus ranges between 26% (Târgovişte) and 22.8% (Titu), which represent lower values than those of the years with precipitation shortage (SPA<-0.5). It results that the normal years from a pluviometric viewpoint (SPA between -0.5 and 0.5) are predominant throughout the plain region, their frequency being of 43.5% at Târgovişte.

Table 5. *Frequency of the years of pluviometric normality, excess and shortage*

Attribute of the year	**Surplus**		**Shortage**		**Normal**	
SPA	>0.5		<-0.5		-0.5...0.5	
Frequency / Station	Number of cases	%	Number of cases	%	Number of cases	%
Târgovişte	12	26	14	30.4	20	43.5
Titu	10	22.8	14	26.1	22	51.1

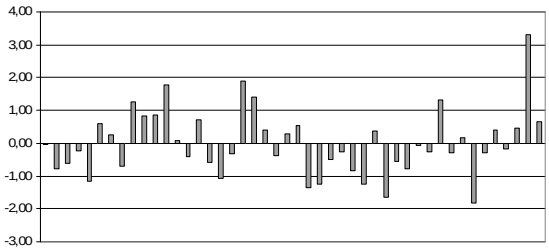

Figure 1. *Annual SPA values in Târgovişte*

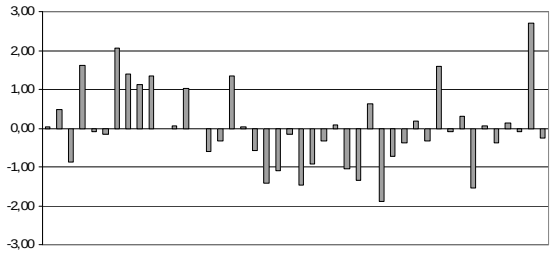

Figure 2. *Annual SPA values in Titu*

The exceptionally rainy and the excessively rainy years have a very low frequency, between 1.0% and 2.2%. Consequently, the surplus is given mainly by the rainy years, whose frequency ranges between 6.4% (Tărgovişte) and 10.9% (Titu).

Table 6. *Frequency of the years with pluviometric surplus*

Station	**Exceptionally rainy**		**Excessively rainy**		**Very rainy**		**Rainy**		**A little rainy**		**Total surplus**	
	>2.5		2.5…2.0		2.0…1.5		1.5…1.0		1.0…0.5		>0.5	
	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%
Târgovişte	1	2.1			2	4.3	3	6.4	6	12.8	12	25.6
Titu	1	2.1	1	2.1	2	4.3	5	10.6	2	4.3	11	23.4

As far as the frequency of the consecutive years with surplus is concerned, there was a clear predominance of the situations with two consecutive years, during the periods 1970-1971 and 1979-1980. The situations with three consecutive years of surplus had a low frequency, just one such case being recorded, at Titu (1970-1972).

The frequency of the seasons with precipitation surplus is completely different. So, most of these seasons occur in spring and the least numerous are recorded during winter.

Table 7. *Frequency of the seasons with pluviometric surplus*

Station	**Exceptionally rainy**				**Excessively rainy**				**Very rainy**				**Rainy**				**A little rainy**				**Total surplus**			
	>2.5				2.5…2.0				2.0…1.5				1.5…1.0				1.0…0.5				>0.5			
	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F
Târgovişte	1		2	1		2			1	1	3	1	4	2	1	6	6	9	6	4	12	14	12	12
Titu	1		1	1	1	2	1	2	3	2	3		1	2	3	4	4	9	4	4	10	15	12	11

W = winter; S = spring; S = summer; F = autumn.

The repartition of the seasons with pluviometric surplus, according to the SPA, highlights the rare occurrence of the exceptionally rainy and excessively rainy seasons, especially during spring and summer. The most frequent very rainy season was summer, while for the cases of rainy season the most frequent season was autumn.

Table 8. *Frequency of the seasons with pluviometric surplus (number of cases)*

Attribute of the season	**Exceptionally rainy**				**Excessively rainy**				**Very rainy**				**Rainy**			
SPA	>2.5				2.5…2.0				2.0…1.5				1.5…1.0			
Station	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F
Târgovişte	1	-	2	1	-	2	-	-	1	1	3	1	4	2	1	6
Titu	1	-	1	1	1	2	1	1	2	2	2	-	2	2	4	4

The precipitation surplus can occur during two or more consecutive seasons. The most frequent coupling was of two consecutive seasons, with a maximum frequency for the coupling spring-summer (both for Târgovişte and for Titu).

There was no record of three consecutive surplus seasons.

Monthly pluviometric surplus

Compared to the values considered as normal, which have a frequency of 37-40%, the highest frequency goes to the months that are a little rainy for each station (9%): Târgovişte 9.2% and Titu 9.6%.

They are followed, in a decreasing order, by the rainy months (5.3% - 7.8%), the very rainy ones (3.5% - 3.7%), the excessively rainy ones (2.0 - 1.6) and then by the exceptionally rainy ones (2.3% - 2.0%).

Table 9. *Frequency of the months with pluviometric surplus*

	Exceptionally rainy		**Excessively rainy**		**Very rainy**		**Rainy**		**A little rainy**		**Total surplus**	
SPA	>2.5		2.5…2.0		2.0…1.5		1.5…1.0		1.0…0.5		>0.5	
Station	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Târgovişte	13	2.3	11	2.0	20	3.5	30	5.3	52	9.2	126	22.3
Titu	11	2.0	9	1.6	21	3.7	44	7.8	54	9.6	139	24.6

The years with pluviometric surplus

Among the excessively rainy years, there are 1969, 1972, 1979, and 2005.

During the ***year 1969***, the surplus varied between 271.0 and 280.9 mm. The meteorologists recorded 927.4 mm at Titu, and 903.7 mm at Târgovişte.

The year 1979 is also part of the category of the extremely rainy years. The pluviometric surplus was of 280.9 mm. Extremely high rain quantities were recorded at Târgovişte (1,015.2 mm).

Then follows the *year **2005***, which recorded extremely large rain values that culminated during the month of August (268.3 mm at Târgovişte, 199.6 mm at Titu). Actually, 1269.7 mm were recorded at Titu, which represents the absolute extreme quantity, and 1026.8 mm at Târgovişte.

Seasons with pluviometric surplus

The ***winter of 1969-1970*** was exceptionally rainy (the precipitations were both liquid and solid). 318.6 mm were recorded at Târgovişte and 325.7 mm at Titu.

The ***summer 1979*** was remarked for its very rich precipitations that reached 443.1 mm at Titu and 605 mm at Târgovişte.

Months with pluviometric surplus

The analysis of the highest monthly quantities of precipitations indicates the possibility of their occurrence during any month of the year, but especially during the months of pluviometric maximum, when the highest values are reached.

October 1972, despite being an autumn month, when the precipitation quantity is generally low, recorded rich precipitations: Târgovişte 242.5 mm and Titu 195.3 mm.

August 1997 was characterized by abundant rains covering a large area: 295.4 mm (monthly absolute maximum) at Târgovişte.

August 2005 was especially rainy almost throughout the plain, both stations recording high values: Târgovişte 268.3 mm and Titu 163.8 mm.

6. PERIODS OF PLUVIOMETRIC SHORTAGE (DROUGHT)

Annual pluviometric shortage

The periods of pluviometric shortage become more serious when a group of years with shortage appear. The most frequent are the short periods of pluviometric shortage, of two consecutive years.

Totaling the periods of pluviometric shortage of different durations, determined according to the SPA criterion, we noticed the fact that the most numerous were recorded at Titu station.

Table 10. *Frequency of the years of pluviometric shortage*

Station	Exceptionally dry		Excessively dry		Very dry		Dry		A little dry		Total shortage		Normal	
	<-2.5		-2.5…-2.0		-2.0…-1.5		-1.5…-1.0		-1.0…-0.5		<-0.5		-0.5…0.5	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Târgovişte					2	4.3	5	10.6	7	14.9	14	29.8	21	44.7
Titu					2	4.3	6	12.8	6	12.8	14	29.8	22	46.8

There are no exceptionally dry and excessively dry years, the frequency increasing from the very dry years (4.3%) to the dry years (10.6%, 12.8%) and a little dry years (14.9-12.8%). The highest frequency is recorded at Târgovişte by the years classified as a little dry (14.9%).

Seasonal pluviometric shortage

Following the variation of the seasonal quantities of precipitations we note the fact that the most significant negative deviations are recorded during summer (90-115 mm). In fall, the negative deviations are of 73.8-73.9 mm, and in winter are recorded the lowest deviations (50-60 mm).

Table 11. *Frequency of the seasons with pluviometric shortage*

Station	Exceptionally dry				Excessively dry				Very dry				Dry				A little dry				Total shortage				Normal			
	<-2.5				-2.5…-2.0				-2.0…-1.5				-1.5…-1.0				-1.0…-0.5				<-0.5				-0.5…0.5			
	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F
Târgovişte						1				3	1		6	3	6	4	10	5	9	11	16	12	16	15	19	21	16	20
Titu						1				3	1		5	4	5	4	11	4	1	15	16	12	17	19	21	20	18	17

There are no exceptionally dry seasons, and the highest frequency of the seasons with different degrees of dryness goes to the autumn (3-15%).

Knowing the succession from one year to the next of the seasons with pluviometric shortage is especially important. Therefore, the winters and springs with shortage can come three years in a row, the summers and autumns with shortage can occur for two years on end, while the winters with shortage, at all the stations, never occurred during two consecutive years.

It is also important to know the frequency of the occurrence of a succession of two seasons with pluviometric shortage during the same year. In this sense, we noticed that the highest frequency was recorded at Titu station (15%). This explains the fact that these areas are exposed to the phenomenon of humidity shortage, which can last for a longer period of time

Monthly pluviometric shortage

Compared to the values considered as normal (38.3 - 44%), the highest frequency, at each station, goes to the months considered a little dry (23-27.8%). This frequency records a slight decrease from 27.8% at Titu to 23% at Târgovişte.

They are followed, in a decreasing order of their frequency, the dry months (8.9 - 10.1%), with a lower value for Titu and a higher value for Târgovişte. The very dry months have very low occurrence values (0.4%), and there are no excessively or exceptionally dry months for either of the two meteorological stations.

The most frequent very dry months are October-November (Târgovişte) and October (Titu).

Table 12. *Frequency of the months of pluviometric shortage*

Station	**Exceptionally dry**		**Excessively dry**		**Very dry**		**Dry**		**A little dry**		**Total shortage**		**Normal**	
	<-2.5		-2.5…-2.0		-2.0…-1.5		-1.5…-1.0		-1.0…-0.5		<-0.5		-0.5…0.5	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Târgovişte					3	0.5	57	10.1	130	23	190	33.7	248	44.0
Titu					2	0.4	50	8.9	157	27.8	209	37.1	216	38.3

Years of pluviometric shortage

During the last century, in the Târgovişte Plain, among the most significant very dry or excessively dry years there were the years of 1982, 1985, 1992, and 2002.

During the dry years with the most significant precipitation shortage, much lower annual quantities are recorded than the multiannual average values. At Titu, in 1992, only 314.8 mm were recorded; at Târgovişte 354.9 mm were registered in 2000.

In ***the year 1992***, the intense anticyclonic activity triggered a substantial decrease in the quantities of precipitations, so that this year is part of the category of the excessively dry years, according to the SPA values. Out of the 12 months of the year, 11 recorded a pluviometric shortage, 4 of them being very dry (January, February, September, November). The quantity of precipitations was less than 400-500 mm: Titu 314.8 mm and Târgovişte 388.1 mm.

Seasons of pluviometric shortage

The spring of 1968 was excessively dry, the quantities of precipitations being very low: Târgovişte 43 mm (compared to 149.5 mm – the multiannual average), Titu 23.1 mm (compared to 168.9 mm).

The ***winter of 1993*** represented a dry period during which the quantities of precipitations decreased to 42.2 mm at Titu, and to 58.1 mm at Târgovişte, representing 30-40% of the winter's average multiannual value.

Months of pluviometric shortage

During the year, the highest precipitation deficit occurs in spring (March, April), summer (July, August), and autumn (September).

March 1961 recorded an intense drought (a shortage of 20-35 mm). An average of precipitations of 3.5-4 mm was recorded at Târgovişte (3.5 mm).

March 1990 remains one of the driest months in the Târgovişte Plain, the shortage of precipitations (90-95%) being accentuated also by the high temperatures (the maximum values were above 20°C at some stations). The quantities of precipitations summed up a few mm, namely 0.1 mm at Târgovişte and 0.6 at Titu.

March 2002 was a month of intense drought for Târgovişte (1.4 mm), while for Titu the value of the precipitations during this month was of 10.9 mm.

October - November 1969 were the driest months in the Târgovişte Plain, both because of the area affected and because of the inexistence of precipitations, for Titu and Târgovişte (0.0 mm).

In October and November 2002, a similar situation occurred, but this time 0.2 mm of precipitations were recorded in Târgovişte.

November 1965 was a month of shortage, the quantities of precipitations being less than 15 mm: Titu 0.2 mm, Târgovişte 10.7 mm.

7. THE IMPACT OF THE PERIODS OF PLUVIOMETRIC SURPLUS AND SHORTAGE ON THE ENVIRONMENT

7.1. Impact of the periods with pluviometric surplus on the environment

The torrential rains have very high intensities, around 2.40 mm/min. During the interval between 1961 and 2007, on the territory of the Târgovişte Plain, there were rains whose intensity ranged between 0.66 and 3.50 mm/min. The frequency of the rains of high intensity is present during the interval June-August, these rains having a local convective character, the cloud that generates them covering an area of maximum 10 km.

The highest annual quantities of precipitations during the interval 1961-2007, went beyond 155.6 mm in the urban area of Târgovişte during the month of October, this being the absolute value for the period. It has an accidental character, overpassing by 55 mm the multi-monthly average of the rainiest month – June – which is of 100.5 mm. Expressed in percentages, this pluviometric value represents 510% compared to the multi-monthly quantity of the month of October and 25% of the multiannual quantity of precipitations specific for the Târgovişte Plain (Păun, 2004).

The structure of the pluviometric regime of the precipitations leads to the determination of some conventional categories of limits for the situation when the water quantity that fell went beyond certain thresholds. For the Târgovişte Plain, during the interval under consideration, the highest frequency goes to the low quantities of precipitations, ranging between 20.1 and 40 mm in 24 hours, summing up a number of 5 cases / year (42%). The maximum quantities in 24 hours ranging between 60.1 and 80 mm sum up 4 cases / year (33%). With the increase of the interval value over 80 mm, the number of cases gets close to 1. For the rural area, at Valea Voievozilor, there is no record of maximum precipitations of over 80 mm in 24 hours.

Case study – the rain of 18-19 July 2002

A special phenomenon for the region under analysis is the downpour of July 18-19, 2002. The beginning of the rainfall was situated around 11.30 p.m., and the downpour did not have a continuous character, the total of the interruptions summing up 92 minutes. The first intensity of the rainfall was of 2.33 mm/min at 1.09 a.m., lasting for 4 minutes and pouring a quantity of 9.3 mm of water. After this moment, the rain became more intense and recorded an intensity of 3.10 mm/min during 3

minutes, summing up 9.3 mm of water. This intensity of the rainfall was recorded at 1.32 a.m., lasting for 3 minutes, after the recording of 75.0 mm of water since the beginning of the rain (Păun, 2004). During this interval, the meteorological conditions were as follows: slightly increasing atmospheric pressure, 735.4 mmHg, decreasing air temperature, 16.1°C. After 1.40 a.m. – when the total quantity that had been recorded up to that moment was of over 84 mm precipitations, the intensity of the downpour decreased continually until 2.09 a.m. – when the intensity of 1.00 mm/min was reached, after which the intensity became lower than this value until the rainfall stopped (at 6.0 a.m.).

The abundant and long-term precipitations are the most frequent and with the most significant negative effects, by generating floods, landslides and erosion.

The specific features of the general atmospheric circulation during the transitional seasons determine a higher frequency of the long-term rains (from one to several days). Sometimes they can have favorable consequences on the environmental quality (ensuring the underground water reserve, purifying the atmosphere), but more often they have unfavorable effects. The air and soil humidity can cause numerous damages to the vegetal layer, cultivated plants, vegetables, fruit-bearing trees; the significant water quantity can lead to an excessive water quantity in the soil, an increase of the level of the water-bearing structure, floods in the watersides. In these places, the vegetation cannot breathe, turns yellow and dry and the cultivated areas are totally destroyed.

A brief inventory of the disastrous consequences of these extremely abundant precipitations highlights the significant damages suffered by the environment and the society.

During the interval of 1971-2005, because of the significant rainfalls with high intensity and humidity surplus, generalized in the hydrographic basins of the Dâmbovița and the Ialomița Rivers, important high floods, catastrophic by their effects occurred during the years 1972, 1975, 1991, 1997, 2001 and 2005, with flows between 300-700 m³/sec, for the main rivers, and 200-250 m³/sec, for the tributaries.

In the hydrographic basin of the Ialomița River, there were significant high floods along the years, out of which the most representative were in August 2-4, 1997, when the recorded flows were between 150 m³/sec and 200 m³/sec, reaching a maximum of 563 m³/sec at Târgovişte, and in June 2001, when the high flood reached a climax, by its size and through the participation of the whole basin up to Târgovişte.

The most spectacular effects occurred on the slope lands in the Târgovişte Plain. Along the main rivers and along the tributaries catastrophic high floods occurred. In the hydrographic basins, the effects of the high floods were extremely strong.

The abundant rains and floods occurred in the year 2005 determine its character of exceptional year, with a very rainy spring and summer. The area covered by these phenomena corresponded to almost the entire surface of Romania, from April until September, period during which the Târgovişte Plain was affected as well. In the year 2005, in the Târgovişte Plain, the highest quantity of precipitation fell in August: 268.3 mm/m^2 recorded at the meteorological station in Târgovişte.

An area affected by these rainfalls included the commune of Aninoasa, situated nearby the town of Târgovişte, being composed of the villages of Aninoasa, Săteni, Viforâta. Landslides occurred in this case. The physical-chemical properties of the soil or of the combined soil formations, especially through the superficial deposits, are essential in the water circuit having a different influence on the evaporation, infiltration, or superficial leaking of the precipitations. Directly dependent on the lithological character of the bedrocks on which it was formed, the soil has a strong influence on the infiltration rate, through its degree of permeability, its texture, and its structure. When the infiltration rate is lower than the intensity of the rainfall, a superficial leaking appears, directly dependent on the slope on which the water leaks and the size of the surface that receives the surplus water.

In the present case, the lithology of the surface deposits formed of clays and marls plays an extremely important role in triggering the landslides. The presence of an inclined argillaceous layer, over which there is a drenched permeable layer, is the essential condition for the triggering of landslides. Therefore, in Aninoasa, the landslides caused by the floods of April 2005, combined with

the melting of snow, affected *0.03 km of the county road DJ 712 A from the national road DN 72 towards Dealu Monastery; 30 m of wall from the villa of the personnel serving at the hospital; the pillar no. 16 supporting the electrical network.* Moreover, *10 households; 4 ha of land under cultivation; 4 wells with drinkable water* were also flooded in the commune of Aninoasa during this period. The floods of the month of May affected 15 ha of land under cultivation; 5 dwellings; 0.035 km of county road.

The downpours of August 14-25, 2005 affected the commune of Aninoasa even more: 60 dwellings; 177 additions to household structures; 8 bridges; 2.11 km of county and communal road; 29 ha land under cultivation; 250 dead animals. The downpours of September 1, 2005 affected 0.3 km of the county road DJ 718 A, a fence consolidating the descent was broken. From the above-mentioned aspects, we can notice that floods can affect, at least temporarily, the quality of the environment, and the negative effects of these phenomena affect the economy, the social life and even the physical environment.

The high quantities of precipitations fallen in the spring of 2005 affected Valea Voievozilor as well, a village that is part of the commune of Răzvad, situated near the town of Târgovişte. They led to the occurrence of floods, causing damages in the households and for the land under cultivation.

These floods did not cause the loss of human lives, only four inhabitants were hospitalized at the County Hospital with the diagnosis of panic attack (in the Dâmbovița County these floods resulted in just one victim).

Talking to some of the inhabitants of this village, we noticed that one of the risky climatic phenomena that frightens them the most are these downpours, both the torrential ones and the long-term ones, one of the reasons being the fact that a part of the food is assured by their own agricultural production. Another reason would be the quite low financial possibilities of some inhabitants when it comes to repairing the damages caused by such phenomena.

Another locality affected by the floods of 2005 was the commune of Sălcioara (comprising the villages of Băneşti, Cătunu, Cuza Vodă, Ghineşti, Mircea Vodă, Moara Nouă, Movila, Podul Rizii and Sălcioara).

In the village of Movila, there were several households flooded because of the local people's lack of care for the fact that there were no ditches for the rainwater and a bridge was blocked by waste. It was necessary for the Environmental Guard (Garda de Mediu) to intervene for the achievement of some works related to the ditches gathering the rainwater. In Ghineşti, in the area of the bridge over the Dâmbovița, following the increase in the water level, the Dâmbovița river caused high floods and eroded some areas. In Mircea Vodă, 1 ha of land under cultivation was affected and it was impossible to be used again because a marsh appeared. In the same commune, the rains of July 12 affected 50 ha of land under cultivation, destroying the plants on a part of this land.

The rains of 2005 affected also the town of Târgovişte, especially those of August 5-8. Three points were most affected: the County Hospital, Valahia University and the entrance in Târgovişte from Priseaca.

The reasons that led to blocking the access to the town from the direction of Priseaca are: the significant quantity of precipitations fallen in a short period of time, the lack or the clogging of the ditches along the areas limited by descents, the lack of sidewalks in the case of the roads situated higher than the level of the surroundings, the lack of junctions between the ditches of the access roads and those of the main roads, the clogging of the valleys of the rivulets in the area, inadequately dimensioned ditches. This is what led to the flooding of the national road DN 72 A and blocked the road traffic, and flooded 40 households situated next to this national road. The downpours of August 14-25 affected *10 households, 0.2 km road, 8 electrical networks* in Târgovişte.

Following the abundant precipitations of that year (2005), more flooding occurred as well in other areas than the above-mentioned ones, namely: Lucieni – the rains of May 7-10, 2005 affected 20 households, 600 household annexes, 1 km of county road, 20 ha land used in agriculture, while those of September 19-25 affected 75 household annexes, 6 km of county and communal road, 20 ha land under cultivation, 35 wells; Ulmi – the rains of May 7-10, 2005 affected a bridge, 10 ha land under

cultivation, a defense dam, those of August 14-25 affected 12 household annexes, 1 km of county and communal road and those of September 19-25, 14 household annexes, 0.2 km forest road, 30 ha land used in agriculture, 60 wells; Văcăreşti - 20 ha land under cultivation were affected by the rains of May 7-10 and 17 household annexes by those of July 12; Nucet – 0.03 km of county and communal road affected by the rains of August 5-8, while the rains of September 19-25 affected 6 houses, 67 household annexes, 12 km of county and communal road, 30 wells.

On June 26, 2007, strong storms affected several localities of Dâmbovița County (Băleni – large areas used in agriculture), the national road DN 72, Târgovişte-Găeşti was blocked for over an hour, scores of trees were felled, hundreds of cars, the electrical and telephonic networks, and the water supply system were damaged.

7.2. The impact of the periods of rain shortage on the environment

The effects of drought consist in: it amplifies the thermal effect; it increases the potential evaporation and transpiration, the humidity shortage in the soil becomes maximum.

The drought is conditioned by the active surface, by the quantity of precipitations accumulated in the soil, by the air temperature, by the evaporation, by human activity etc. The characteristic periods when this phenomenon occurs are the months of June-August, and during the last years, this period included September as well. In the area of Târgovişte Plain, the recorded droughts had negative effects on the land under cultivation, on animal raising, determined the decrease of the water resources in the rivers and in the water-bearing structures, difficulties in the functioning of the micro power plants. The lack of precipitations and the heat accentuated the drought for a long period of time, and turned the summer of the year 2000 into the driest summer of the last 100 years, the indicator temperature-humidity recorded for the entire period being over 65%.

The river flow regime and the lake's hydro balance are strongly affected, recording a water flow, level, and surface decrease, sometimes drying up, while the micro power plants and the river transport have difficulties in functioning. Consequently, the level of water in the water-bearing structures and in the wells decreases.

In the soil, following the intense evaporation phenomena, natural phenomena of increase in the salt level in soil appear, with the formation of efflorescences.

Finally, the environmental and life quality is influenced, through the poor or absent food resources, and through the increase in morbidity among animals and population. The most conclusive examples in this sense are: in the year 2000- *July 5, 10 fires occurred (destroying 3000 m^2 wheat field near COS Târgovişte; 500 kg straws in Ulmi; 800 m^2 of dry vegetation on Calea Câmpulung; and other smaller fires in Dragomireşti, Lucieni, Gura Şuții); 2007- July – the corn fields were affected in a proportion of 90% in the localities of Sălcioara, Produleşti and 80% of the potato fields were affected in the locality of Finta; 2007- August 25, a large fire destroyed 6 ha of land under cultivation (Source - Direcția Agricolă Dâmbovița/ The Agricultural Direction of Dâmbovița County).*

The evolution of the hydrometeorological situation and of the recordings made throughout the country during the autumn of 2006 and by the middle of the year 2007, highlighted the fact that the maximum temperature of June 26, 2007 got close to the absolute maximum recorded in June 70 years ago, being just one tenth of degree Celsius away from it.

CONCLUSIONS

Through the features of their evolution, the climatic hazards develop in cascade, generating other environmental risks as well. The climatic hazards are defined through heat and cold waves recorded as absolute maximum and minimum temperatures, extreme precipitations, droughts, some of them having negative consequences, not only through the material damages they cause, but also through the accentuation of the pollution phenomenon.

Because of their impact on the environment and on the socio-economic activities, the climatic hazards trigger natural and ecological imbalances, influencing the ecosystems' evolution.

The quantities of precipitations of 2005 affected the Târgovişte Plain, where, because of this phenomenon, several villages were flooded (Valea Voievozilor, Sălcioara, Lucieni, etc.). These floods did not cause the loss of human lives, but they had a negative impact on the cultivated land, on the land by causing landslides, on the roads.

Among the geographical factors with a major impact on the environment and with direct repercussions on its quality, the climatic ones occupy an essential place. Among the climatic changes, the extreme variations of the meteorological phenomena and especially of the air temperatures and of the quantity of precipitations fallen occupy a determining role, laying at the basis of the imbalances that appear in the hydrometeorological regime. Yet, all these are in correlation with the human activity. The disorganized irrational deforestations, the afforestations achieved very late, the extension of the land under cultivation, or sometimes uncultivated, the irrational grazing, agrotechnical methods used and applied randomly are just a few of the anthropic actions with a negative impact on the environment. The vegetal layer participates directly or indirectly to taking over the water from precipitations, determining the proportion in which this water is kept or given back to the environment through evaporation and transpiration. The more abundant the vegetation is, the less intense the impact of the atmospheric precipitations on the environment is.

The sustainable development of the Târgovişte Plain makes it necessary to be aware of the impact produced by the natural hazards on the environment and requires the participation of the authorized institutions to the solution of these problems.

REFERENCES

ALEXE, RĂDIŢA (2005*), Special climatic effects in the urban ecosystem of Târgovişte*, Annals, Geographical Series, Tome 4-5, Valahia University of Târgovişte, Departament of Geography, Valahia University Press, Târgovişte.

ALEXE, RĂDIŢA (2007*), Ecosistemul urban Târgovişte. Habitat, societate, mediu* [Urban Ecosystem of Târgovişte. Habitat, Society, Environment], Editura Transversal, Bucureşti.

BĂLTEANU, D. (2004), *Hazardele naturale şi dezvoltarea durabilă* [Natural Hazards and Sustainable Development], Revista Geografică, X, Institutul de Geografie, Academia Română, Bucureşti.

BĂLTEANU, D., ALEXE, RĂDIŢA (2000), *Hazarde naturale şi antropogene* [Natural and Anthropogenic Hazards], Editura Corint, Bucureşti.

BOGDAN, OCTAVIA, NICULESCU, ELENA (1999), *Riscurile climatice din România* [Climate Risks in Romania], Imprint by Compania Sega Internaţional, Bucureşti.

DRAGOTĂ, CARMEN-SOFIA (2006), *Precipitaţiile excedentare în România* [Excess Precipitations in Romania], Editura Academiei Române.

DUMITRAŞCU, MONICA, DUMITRAŞCU, C., DOUGUEDROIT, ANNICK (2001), *Seceta şi impactul acesteia asupra mediului în Câmpia Olteniei* [Drought and Its Impact upon Environment in the Oltenia Plain], Revista Geografică, VII, Institutul de Geografie, Academia Română, Bucureşti.

GÂŞTESCU, P. (2003), *Resursele de apă din unităţile de câmpie din România- acţiuni de gospodărire* [Water Resources in the Plain Units of Romania – Management Actions], Analele Universitatăţii Valahia, Seria Geografie, Tomul 3, Târgovişte.

PĂUN, C. (2004), *Cantitatea şi intensitatea precipitaţiilor maxime căzute în 24 de ore pe Câmpia Înaltă a Târgoviştei* [Amount and Intensity of Maximum Precipitation in 24h in the High Plain of Târgovişte], Revista Geografică, T.X- 2003- Serie Nouă.

PEHOIU, GICA, MUICĂ, CRISTINA, SENCOVICI, MIHAELA (2006), *Geografia mediului cu elemente de ecologie* [Environmental Geography with Elements of Ecology], Editura Transversal, Târgovişte.

SENCOVICI, MIHAELA (2009), *Studiul geografic al mediului în Câmpia Înaltă a Târgovişteirezumatul tezei de doctorat* [Geographic Study on Environment in the High Plain of Târgovişte – Abstract of Doctoral Thesis], Editura Transversal, Târgovişte.

TANISLAV, D., COSTACHE, ANDRA (2007), *Geografia hazardelor naturale şi antropice* [Geography of Natural and Anthropogenic Hazards], Editura Transversal, Târgovişte.